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RESEARCH MEMORANDUM

THE EFFECT OF SEA/ SHORE ROTATION ON ENLISTED SKILL UTILIZATION

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THE EFFECT OF SEA/SHORE ROTATION ON ENLISTED SKILL UTILIZATION

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ABSTRACT

This research memorandum examines one of the major constraints on skill utilization for Navy enlisted personnel: the requirements for sea/shore rotation. It presents a simple model of the relationship between the rotation policy for a skill community and the utilization rate for that skill. The model can be used to calculate the number of people needed to keep requirements filled while maintaining the prescribed rotation patterns. The model is applied both to ratings and to Navy Enlisted Classification codes (NECs).

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INTRODUCTION

For Navy enlisted personnel, a rating is a career field that requires related aptitudes, knowledge, training, and skills. Ratings are the primary means of identifying billet requirements and personnel qualifications. Navy Enlisted Classification codes, or NECs, are codes for "special knowledge and skills that identify personnel and requirements when the rating structure is insufficient by itself for manpower management purposes", [1, p. 1]. Although ratings, or occupations, are generally earned in A-school, NECs are usually earned in C-school. (Some ratings and NECs can be earned on the job.) An individual has only one rating at a time, but he may hold any number of NECs.

One question of interest to Navy manpower managers is whether individuals use the skills they have acquired. This can be determined by examining duty assignments. Most individuals are assigned within their rating, but they are generally not required to use their NECs at any given time. Making use of an individual's NECs is only one of several policies affecting job assignment. Other policies include: minimizing the costs of a transfer, satisfying duty preferences, providing a variety of duty assignments over the person's career, and minimizing the time billets are unfilled.

One goal of the Requirements for Individual Training Study is to examine how NECs are used and the constraints on NEC use. An earlier paper [2] presented various measures of NEC utilization at the aggregate level; future papers will provide measures of utilization at the NEC level, both cross-sectional and over time. This paper examines one of the major constraints on NEC utilization: the requirement for sea/shore rotation.

All enlisted personnel are required to spend some of their time at sea and some ashore. Prescribed sea tours and normal shore tours generally vary by rating and paygrade, although some NECs have their own tour lengths. Theoretically, "the length of tours at sea and ashore for each rating depends primarily on the ratio of shore billets to sea billets" [3, article 3.04]. In practice, however, tour lengths seem to be determined more by the desire to ensure equity of sea duty among ratings than by the proportion of billets at sea.

As will be shown below, if the distribution of billets between sea and shore for a skill community is not compatible with prescribed tour lengths for that community, an inventory in excess of requirements will be needed to keep all the billets filled. The size of that inventory is determined by means of a simple model, which is presented in the next section. The model is applied first to ratings and then to NECs.

AN INVENTORY MODEL

Description

Within a community of rating or NEC holders, let

C = requirements at sea (number of billets)

S = requirements ashore

R = total requirements = $C + S$

N_C = number of people in sea billets

N_S = number of people in shore billets

I = $N_C + N_S$ = actual inventory

I^* = inventory needed to fill all billets throughout the rotation cycle.

The minimum value for I^* would be R. It is desired to determine when $I^* = R$ and when it exceeds R. In the latter situation, what is the formula for I^*?

Another concept of interest is utilization. The utilization rate for a community is the ratio of the number of people possessing and using the skill to the total number possessing the skill, where using a skill means being assigned to a job that requires it. If the number of people possessing the skill is less than or equal to requirements and if all those possessing the skill are assigned to jobs requiring the skill, the utilization rate is 1. If, however, inventory exceeds requirements, the utilization rate will be less than 1. Assuming that only those possessing the skill are assigned to the R jobs requiring the skill and that all requirements are filled, the utilization rate will be $u = R/I$.

If the number of people possessing the skill equals the desired inventory, the utilization rate will be $u^* = R/I^*$. u^* is the maximum utilization rate achievable while filling all sea and shore billets. If the actual inventory is greater than the desired inventory, all the billets will be filled, but the utilization rate will be lower than u^*. If the actual inventory is less than the desired inventory, the utilization rate will be higher than u^*, but not all the billets will be filled.

To keep the model simple, a steady state is assumed: accessions into the community (via new entry or promotion) equal losses from the community (via promotion or discharge). In addition, a constant rotation rate is assumed; that is, the percent of people moving from sea duty to shore duty or vice versa is the same from year to year.

It is useful to distinguish between

$$k^* = Y_C^*/(Y_C^* + Y_S^*) = \text{prescribed percent of time at sea} \quad (1)$$

where Y_C^* = prescribed sea tour and Y_S^* = normal shore tour;

$$k = Y_C/(Y_C + Y_S) = \text{actual percent of time at sea} \quad (2)$$

where Y_C = actual sea tour and Y_S = actual shore tour;

$$C/R = \text{percent of billets at sea; and} \quad (3)$$

$$N_C/(N_C + N_S) = \text{percent of people at sea.} \quad (4)$$

k may differ from k^* because of deviations of actual tours from prescribed lengths. Also, (4) may differ from (3) because of a shortage or surplus of personnel.

Some Conclusions From the Model

If the rotation rate is constant, $N_C/(N_C + N_S) = k$; that is, the percent distribution of people by type of duty can be used to infer the actual rotation ratio. For example, with a 3:3 rotation ratio,[1] 50 percent of the people would be at sea at any given time; with a 3:2 ratio, 60 percent of the people would be at sea.

When the prescribed percent of time at sea equals the percent of billets at sea ($k^* = C/R$), then $I^* = R$ and $u^* = 1$. If, however, $k^* \neq C/R$, then either (1) the inventory needed to fill all the billets while achieving the desired sea/shore rotation pattern will exceed requirements, or (2) actual sea and shore tours will have to be adjusted to keep all the billets filled. In the former situation, $k = k^*$, but $I^* > R$, so that $u^* < 1$. In the latter situation, $I^* = R$ (so that $u^* = 1$), but $k \neq k^*$.

In case 1 above, the required inventory can be derived by solving the following problem:

$$\begin{aligned} &\min_{C^*, S^*} I^* = C^* + S^* \\ &\text{subject to} \quad C^*/(C^* + S^*) = k^* \\ &\qquad\qquad\quad C^* \geq C, S^* \geq S \\ &\qquad\qquad\quad C^*, S^* \text{ integers.} \end{aligned}$$

1. Rotation ratios are generally expressed as the ratio of years at sea to years ashore. The Chief of Naval Operations has established 3:3 as a long-range goal.

This formulation assumes that C and S are minimum requirements for the skill at sea and ashore. The fraction of positions at sea in the required inventory is the same as the prescribed fraction of time at sea. Within the inventory, C^* individuals will be at sea at any given time, and S^* individuals will be ashore.[1]

Ignoring the integer constraint, the solution to the minimization problem is as follows.

- If $k^* < C/R$, there are relatively too many sea billets to achieve the prescribed sea/shore rotation ratio. Thus, only the number of shore billets should be increased:

$$C^* = C, S^* = \frac{(1-k^*)}{k^*} C \ .$$

The resulting utilization rate is

$$u^* = \frac{R}{C^* + S^*} = \frac{k^*}{C/R} \ .$$

- Using similar logic, if $k^* > C/R$, only the number of sea billets should be increased:

$$S^* = S, C^* = \frac{k^*}{1-k^*} S \ .$$

In this case,

$$u^* = \frac{1-k^*}{1-C/R} \ .$$

In case 2, the actual percent of time at sea will equal the proportion of billets at sea (assuming that available personnel are distributed between sea and shore in proportion to the number of billets). Thus, if the prescribed percent of time at sea is greater (less) than the proportion of billets at sea, personnel will spend less (more) than the prescribed amount of time at sea.

1. Reference [4] takes a somewhat different approach. Given I, k is chosen to maximize readiness, where sea and shore billets may contribute differently to readiness. C and S are than determined as kI and $(1-k)I$, respectively.

It should be noted that the cases discussed here represent two extremes. Requirements could also be met by a combination of the two policies: maintaining an inventory in excess of requirements (although not as high as in case 1) and adjusting actual sea and shore tours (although not as much as in case 2).

One conclusion that can be drawn from this discussion is that, if C and S are taken as given and k^* is a policy variable, k^* will be achievable with the minimum number of people if it is set equal to C/R. If, on the other hand, it is desired to achieve a particular value of k^*, C and S should be chosen so that the fraction of billets at sea equals k^*.

The present discussion leads to several questions concerning Navy enlisted ratings and NECs. First, what are the relationships among k, k^*, and C/R for these groups? Second, if $k^* \neq C/R$, are sea and shore tours adjusted to keep all billets filled, or is an inventory maintained in excess of requirements? The following sections will attempt to answer these questions, first for ratings and then for NECs.

APPLICATION TO RATINGS

Table 1 contains data on the prescribed percent of time at sea (k^*), the actual percent of time at sea (k), and the percent of billets at sea (C/R) by rating and paygrade. The sources of the data are as follows.

Reference [5] used the Enlisted Master File to measure the actual percent of time spent at sea for Navy enlisted personnel for different time periods and definitions of sea duty. The numbers in table 1 here were taken from table 3 of that document, which covers the period January 1982 to June 1986 and uses sea/shore codes 2 through 5 to define sea duty.[1]

Prescribed sea tours and normal shore tours, used to compute the desired percent of time at sea, are listed by rating and paygrade—and, in some cases, by NEC and paygrade—in the Enlisted Transfer Manual, Chapter 3 [3].[2] The tables containing tour lengths are updated quarterly. Two of these tables, one from June 1979 and one from January 1987, were used in constructing table 1. These dates were chosen to encompass the time period covered by the

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1. Technically, time in sea/shore code 5 was counted as sea duty only if it followed time in sea/shore code 2, 3, or 4. Sea/shore codes are defined as follows (see [3], article 3.03):

1. Shore duty	4. Nonrotated sea duty
2. Sea duty	5. Neutral duty
3. Overseas shore duty	6. Preferred overseas shore duty.

2. The NECs with special sea and shore tour lengths are primarily the nuclear power NECs (335X, 336X, 338X, 339X), diver NECs (53XX), and medical NECs (HM-84XX and 85XX).

Table 1. Prescribed percent of time at sea (1), actual percent of time at sea (2), and percent of billets at sea (3), by rating and paygrade

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
				Group I: Deck					
BM	(1)	.71	.71	.71-.67	.64-.62	.68-.56	.68-.50	.68-.50	
	(2)	.88	.82	.65	.60	.53	.51	.40	.70
	(3)								.69
MA	(1)			.54	.54	.54	.54	.54	
	(2)			.34	.50	.48	.38	.36	.46
	(3)								.49
QM	(1)	.71	.71	.71-.69	.71-.68	.69-.56	.58-.54	.50	
	(2)	.91	.89	.75	.62	.56	.46	.48	.75
	(3)								.75
SM	(1)	.71	.71	.71-.69	.71-.67	.62-.65	.62-.50	.62-.50	
	(2)	.92	.87	.72	.58	.52	.52	.40	.73
	(3)								.79
OS	(1)	.70-.71	.70-.71	.69-.71	.69-.65	.58-.56	.54-.56	.46	
	(2)	.92	.90	.76	.57	.59	.49	.44	.78
	(3)								.79
EW	(1)	.71-.67	.71-.67	.71-.67	.71-.67	.71-.62	.64-.50	.43	
	(2)	.90	.82	.81	.39	.51	.42	.18	.70
	(3)								.67
ST	(1)							.43-.50	
	(2)							.40	.40
	(3)								.58
STG	(1)	.71-.67	.71-.67	.71-.67	.69-.57	.64-.54	.50-.57		
	(2)	.87	.76	.67	.40	.54	.43		.63
	(3)								.63
STS	(1)	.67	.67	.67-.64	.67	.67	.57		
	(2)	.84	.75	.79	.51	.63	.53		.70
	(3)								.68
OT	(1)	.64-NA	.64-NA	.64-NA	.57-NA	.57-NA	.57-NA	.50-NA	
	(2)	.48	.35	.44	.53	.39	.48	.20	.42
	(3)								.33
OTA[a]	(1)	Not Applicable							
	(2)	.32	.34	.35	.38	.31	.21		.35
	(3)								.36
OTM[a]	(1)	Not Applicable							
	(2)	.00	.38	.30	.29	.28	.14		.29
	(3)								.34

a. Rating not in existence in 1979.

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
				Group II: Ordnance					
TM	(1)	.70	.70-.71	.70	.68-.69	.65	.65	.45	
(SS)		.71-.67	.71-.67	.71-.67	.71-.67				
	(2)	.78	.72	.51	.46	.45	.41	.41	.59
	(3)								.60
GM	(1)						.57-.50	.57-.50	
	(2)						.43	.39	.42
	(3)								.48
GMT[b]	(1)	.52-NA	.50-NA	.50-NA	.50-NA	.50-NA	.54-NA	.50-NA	
	(2)	.79	.84	.68	.53	.59	.51	.45	.68
	(3)								.66
GMM	(1)	.67	.67	.67-.64	.67-.64	?-.57			
	(2)	.80	.84	.65	.56	.54			.67
	(3)								.63
GMG	(1)	.71	.71	.71-.64	.57-.64	.57			
	(2)	.89	.83	.69	.58	.59			.70
	(3)								.71
WT[a]	(1)	NA-.54	NA-.50	NA-.50	NA-.50	NA-.50	NA-.50	NA-.50	
	(2)	1.00	.65	.29	.58	.45	.45	.63	.45
	(3)	No observations							
FC[a]	(1)	NA-.57	NA-.57	NA-.57	NA-.57	NA-.50	NA-.50	NA-.50	
	(2)	.70	.81	.82	.33	.52	.41	.53	.62
	(3)								.68
FT	(1)						.55-.50	.55-.50	
	(2)						.44	.34	.41
	(3)								.63
FTG	(1)	.71-NA	.71-NA	.61-NA	.61-NA	.57-NA			
(SS)		.60-.57	.60-.57	.60-.57	.57	.57			
	(2)	.85	.66	.76	.46	.54			.66
	(3)								.61
FTM[b]	(1)	.71-NA	.71-NA	.71-NA	.71-NA	.55-NA			
	(2)	.80	.70	.67	.43	.46			.64
	(3)								.50
FTB	(1)	.60-.57	.60	.60-.53	.57-.56	.55			
	(2)	.52	.65	.78	.41	.56			.62
	(3)								.60

a. Rating not in existence in 1979.
b. Rating not in existence in 1987.

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
MT	(1)	.57	.57	.57	.57-.55	.55			
	(2)	.73	.74	.58	.60	.53		.62	
	(3)							.65	
MN	(1)	Not Applicable							
	(2)	.53	.41	.36	.42	.34	.37	.19	.40
	(3)								.41
		Group III: Electronics							
ET	(1)	.62	.62	.62-.59	.50-.48	.46	.46-.48	.46	
(SS)		.65	.65	.64-.58	.54	.50	.50	.50	
	(2)	.65	.53	.64	.49	.52	.45	.38	.56
	(3)								.56
DS	(1)	.59	.59	.57-.61	.54-.55	.50-.52	.38-.36	.38-.33	
(SS)		NA-.57	NA-.57	NA-.57	NA-.57	NA-.57	NA-.57	NA-.57	
	(2)	.65	.61	.51	.41	.48	.45	.21	.52
	(3)								.55
		Group IV: Precision equipment							
PI	(1)							.57	
	(2)							.28	.28
	(3)								.50
IM	(1)	.71	.71	.71	.71-.60	.69-.59	.69-.59		
	(2)	.78	.78	.69	.57	.50	.32		.66
	(3)								.63
OM	(1)	.71	.71	.71	.71-.57	.70-.59	.70-.59		
	(2)	.76	.82	.68	.54	.49	.63		.66
	(3)								.59
		Group V: Administrative and clerical							
NC	(1)			?	.50-.54	.50	.50	.50	
	(2)			.54	.42	.31	.25	.23	.35
	(3)								.31
RM	(1)	.65	.65	.62-.57	.62-.64	.62-.53	.59-.56	.54-.52	
	(2)	.64	.63	.54	.53	.52	.45	.34	.57
	(3)								.59

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
CTT	(1)	Not Applicable							
	(2)	.45	.34	.28	.25	.31	.12	.12	.30
	(3)								.28
CTA	(1)	Not Applicable							
	(2)	.23	.14	.22	.24	.20	.15	.12	.20
	(3)								.18
CTM	(1)	Not Applicable							
	(2)	.24	.32	.24	.19	.20	.18	.18	.25
	(3)								.22
CTO	(1)	Not Applicable							
	(2)	.31	.28	.24	.26	.25	.14	.08	.26
	(3)								.27
CTR	(1)	Not Applicable							
	(2)	.48	.41	.30	.29	.28	.16	.14	.33
	(3)								.36
CTI	(1)	Not Applicable							
	(2)	.35	.35	.29	.30	.19	.13	.29	.30
	(3)								.32
YN	(1)	.46	.46	.46	.44	.44	.44	.44	
	(2)	.57	.38	.29	.36	.36	.32	.20	.37
	(3)								.38
LN	(1)			.43	.43	.38	.38	.38	
	(2)			.16	.32	.24	.00	.14	.23
	(3)								.23
PN	(1)	.46	.46	.44	.39-.43	.39-.43	.39	.39	
	(2)	.58	.45	.29	.38	.37	.28	.27	.40
	(3)								.38
DP	(1)	.54-.55	.46-.55	.46-.43	.33	.33	.33	.33	
	(2)	.38	.30	.24	.27	.27	.11	.00	.29
	(3)								.33
SK	(1)	.59-.62	.59-.64	.59-.57	.65-.54	.64-.50	.60-.54	.50-.52	
	(2)	.82	.65	.47	.52	.42	.42	.40	.54
	(3)								.56
DK	(1)	.60	.60-.58	.64-.57	.67-.54	.40-.45	.40-.43	.38	
	(2)	.59	.54	.47	.53	.44	.32	.33	.51
	(3)								.51

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
MS	(1)	.64	.64-.62	.64-.58	.64-.58	.55-.60	.55-.58	.50-.52	
(SS)		NA-.64	NA-.64	NA-.64	NA-.64	NA-.55	NA-.55	NA-.50	
	(2)	.75	.63	.52	.52	.46	.44	.32	.58
	(3)								.65
IS	(1)	.50	.50	.50	.43-.50	.43	.43	.43	
	(2)	.60	.54	.35	.44	.44	.17	.11	.43
	(3)								.45
SH	(1)	.71	.71-.67	.67-.64	.62-.54	.50	.40	.40	
	(2)	.87	.76	.57	.53	.47	.42	.28	.65
	(3)								.74
RP	(1)	NA-.50	NA-.50	NA-.50	NA-.50	NA-.50	NA-.50	NA-.50	
	(2)	.55	.45	.31	.44	.37	.08	.13	.40
	(3)								.51
JO	(1)	.46-.57	.46-.57	.46-.52	.43-.52	.38-.43	.38-.43	.38-.43	
	(2)	.52	.49	.31	.34	.27	.12	.22	.36
	(3)								.45
PC	(1)	.59-.64	.59-.64	.59-.64	.59	.54	.50	.46	
	(2)	.70	.64	.53	.55	.52	.13	.01	.58
	(3)								.63
		Group VI: Miscellaneous							
LI	(1)	.59	.59	.59	.59	.59-.54	.59-.54	.50	
	(2)	.76	.62	.47	.55	.58	.44	.00	.56
	(3)								.66
DM	(1)	.43	.43	.43	.43	.36	.36	.36	
	(2)	.69	.44	.33	.38	.10	.00	.00	.36
	(3)								.31
MU	(1)	.50	.50	.50	.50	.50	.50	.50	
	(2)	.24	.21	.18	.13	.14	.15	.14	.18
	(3)								.13
		Group VII: Engineering and hull							
MM	(1)	.71	.71	.71	.71-.68	.70-.59	.70-.61	.70-.61	
(SS)		NA-.62	NA-.62	NA-.62	NA-.62	NA-.62	NA-.50	NA-.50	
	(2)	.90	.73	.75	.62	.60	.51	.45	.71
	(3)								.74

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
EN	(1)	.54-.69	.54-.69	.54-.60	.54-.60	.54-.57	.54-.57	.54-.57	
	(2)	.73	.76	.55	.54	.50	.41	.43	.63
	(3)								.66
MR	(1)	.69	.69	.69	.62-.57	.62-.52	.62-.50	.62-.60	
	(2)	.62	.82	.65	.61	.57	.42	.35	.67
	(3)								.67
BT	(1)	.71	.71	.71	.71	.70-.57	.70-.61	.70-.62	
	(2)	.91	.84	.68	.61	.57	.44	.47	.73
	(3)								.77
EM	(1)	.60-.67	.60-.67	.60-.67	.60-.64	.57-.62	.57-.62	.57-.62	
	(2)	.85	.71	.75	.59	.59	.51	.46	.69
	(3)								.69
IC	(1)	.71	.71	.71	.71	.67-.56	.64-.56		
(SS)		NA-.67	NA-.67	NA-.67	NA-.67	NA-.67	NA-.50		
	(2)	.87	.85	.76	.58	.57	.49		.74
	(3)								.72
HT	(1)	.71	.71	.71	.71-.67	.62-.61	.62-.61	.62-.61	
	(2)	.81	.85	.73	.60	.57	.53	.48	.72
	(3)								.73
GS	(1)						.57	.57	
	(2)						.52	.47	.51
	(3)								.65
GSE	(1)	.62	.62	.57-.54	.57-.54	.57-.52			
	(2)	.81	.72	.83	.49	.56			.67
	(3)								.60
GSM	(1)	.62-.71	.62-.71	.57-.60	.57-.60	.57			
	(2)	.86	.84	.79	.47	.61			.73
	(3)								.73
ML	(1)	.71	.71	.71-.67	.71-.67	.70-.64	.70-.57	.57-.50	
	(2)	.92	.88	.76	.61	.47	.61	.29	.72
	(3)								.71
PM	(1)	.71	.71	.71-.64	.71-.67	.70-.57			
	(2)	.86	.72	.70	.52	.41			.63
	(3)								.69

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
				Group VIII: Construction					
CU	(1)							.50-.48	
	(2)							.31	.31
	(3)								.36
EA	(1)	.67-.60	.67-.60	.67-.60	.52-.48	.50	.50-.48		
	(2)	.63	.70	.65	.40	.46	.22		.56
	(3)								.51
BU	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50-.48		
	(2)	.71	.78	.58	.46	.42	.31		.62
	(3)								.58
SW	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50-.48		
	(2)	.61	.73	.61	.43	.53	.36		.60
	(3)								.58
EQ	(1)							.50-.48	
	(2)							.35	.35
	(3)								.32
EO	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50-.48		
	(2)	.62	.73	.57	.42	.40	.33		.58
	(3)								.57
CM	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50-.48		
	(2)	.70	.77	.58	.42	.40	.33		.60
	(3)								.57
UT	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50-.48	.50	
	(2)	.70	.75	.52	.38	.38	.32	.51	.56
	(3)								.54
CE	(1)	.67-.60	.67-.60	.67-.60	.52	.50	.50		
	(2)	.57	.73	.59	.41	.34	.34		.56
	(3)								.54
				Group IX: Aviation					
AF	(1)							.50	
	(2)							.40	.40
	(3)								.44
AD	(1)	.54-.52	.54-.52	.54	.50-.48	.50-.46	.50-.48		
	(2)	.49	.50	.46	.49	.44	.47		.48
	(3)								.43

Table 1. (Continued)

Rating		Paygrade							
		E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
AM	(1)						.55		
	(2)						.45		.45
	(3)								.48
AMS	(1)	.50-.54	.50	.50-.54	.50	.50			
	(2)	.58	.55	.41	.48	.47			.49
	(3)								.51
AMH	(1)	.50	.50	.50-.52	.50	.50			
	(2)	.63	.55	.45	.51	.49			.52
	(3)								.46
AME	(1)	.50	.50	.50-.54	.50	.35-.50			
	(2)	.59	.58	.43	.50	.41			.51
	(3)								.47
AV	(1)							.50	
	(2)							.39	.39
	(3)								.46
AT	(1)	.50-.54	.50-.54	.50-.56	.50	.46	.46-.50		
	(2)	.53	.51	.43	.44	.44	.45		.47
	(3)								.49
AX	(1)	.54	.54	.54-.56	.54-.50	.50-.46	.50		
	(2)	.59	.54	.51	.48	.52	.38		.52
	(3)								.45
AQ	(1)	.54-.56	.54-.57	.54-.57	.50-.48	.50-.54	.50-.54		
	(2)	.59	.59	.48	.43	.40	.44		.50
	(3)								.49
AE	(1)	.50-.54	.50-.54	.50-.54	.50-.52	.50	.50		
	(2)	.53	.55	.44	.47	.44	.45		.49
	(3)								.48
AW	(1)	.59	.59	.57	.54-.52	.54-.50	.57	.50-.43	
	(2)	.62	.82	.64	.48	.46	.38	.16	.61
	(3)								.50
AO	(1)	.64	.64-.65	.62	.64-.61	.54	.50	.50	
	(2)	.70	.73	.54	.55	.47	.42	.37	.61
	(3)								.59
AC	(1)	.60-.50	.43	.38-.43	.35-.38	.35-.34	.35-.38	.35-.38	
	(2)	.30	.24	.26	.26	.31	.16	.15	.26
	(3)								.29
AB	(1)						.57-.50	.50	
	(2)						.53	.49	.52
	(3)								.56

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
ABE	(1)	.60-.65	.60-.62	.64-.67	.64-.58	.52-.58			
	(2)	.87	.75	.52	.61	.50			.64
	(3)								.73
ABF	(1)	.64	.64-.65	.64	.64-.58	.64-.55			
	(2)	.84	.72	.59	.62	.52			.67
	(3)								.70
ABH	(1)	.64	.64	.64	.64-.58	.50			
	(2)	.77	.66	.56	.62	.53			.63
	(3)								.63
PR	(1)	.46	.46-.44	.50-.52	.40	.40-.38	.50-.40	.50	
	(2)	.54	.51	.42	.44	.32	.21	.14	.45
	(3)								.43
AG	(1)	.50	.43-.50	.43-.50	.43-.46	.35-.38	.35-.50	.35-.38	
	(2)	.58	.42	.30	.37	.37	.32	.21	.38
	(3)								.43
TD	(1)	.43	.43	.43	.43	.43	.43	.43	
	(2)	.01	.03	.03	.06	.00	.02	.00	.02
	(3)								.01
AK	(1)	.62	.50-.57	.50-.60	.46-.50	.41	.41-.45	.41-.54	
	(2)	.58	.54	.37	.42	.38	.30	.27	.45
	(3)								.46
AZ	(1)	.50	.50	.50-.54	.46-.48	.35-.43	.35-.43	.35-.50	
	(2)	.56	.51	.37	.43	.37	.25	.25	.43
	(3)								.44
AS	(1)				.43-.41	.40-.44	.43-.45	.50	
	(2)				.39	.35	.37	.15	.38
	(3)								.28
ASE	(1)	.46	.46	.46-.52					
	(2)	.57	.48	.33					.42
	(3)								.35
ASM	(1)	.46	.46-.44	.46					
	(2)	.62	.49	.35					.44
	(3)								.36
PH	(1)	.54-.50	.54-.56	.54	.50-.41	.46-.41	.46-.43	.43	
	(2)	.47	.49	.41	.44	.33	.39	.29	.44
	(3)								.47

Table 1. (Continued)

Rating		Paygrade E-3	E-4	E-5	E-6	E-7	E-8	E-9	Total
				Group X: Medical					
HM,HN	(1)	.40-.50	.50	.50-.43	.50-.43	.40-.43	.40	.40	
	(2)	.32	.35	.27	.39	.40	.35	.20	.33
	(3)								.28
				Group XI: Dental					
DT,DN	(1)	.50-.43	.50-.43	.50-.43	.50-.43	.50-.43	.40-.41	.40-.41	
	(2)	.23	.32	.33	.36	.39	.20	.00	.31
	(3)								.28
Total									
	(2)[c]	.67	.63	.54	.49	.48	.42	.36	.57
	(3)[c]								.55

c. Includes General Apprenticeship ratings.

estimates of actual percent of time at sea.[1] Where two numbers are listed under "prescribed percent of time at sea" for a paygrade, the first number comes from the 1979 table and the second from the 1987 table. For some ratings, special sea/shore rotation requirements for submarine personnel are listed separately under the heading (SS).

Several ratings—Ocean Systems Technician (OT), Mineman (MN), and Cryptologic Technician (CT)—are not subject to sea/shore rotation in the usual sense. Since 1981, rotation for the OT rating has been based on a division of duty into Arduous, Preferred, and Other. The MN and CT (CTT, CTA, CTM, CTO, CTR, CTI) ratings rotate between CONUS and OUTUS types of duty.

The percent of billets at sea was calculated using the November 1985 Enlisted Billet File. Planned Authorizations for the Current Fiscal Year (FY 1986) was used to represent the number of billets, and sea/shore codes 2 through 5 were used to define sea duty. To keep the table simple, percent of billets at sea is not broken down by paygrade.

1. The 1979 table was used because individuals serving a tour in January 1982 could have had the tour length set as much as five years earlier.

Before comparing the three sets of figures in table 1, several points should be noted. First, the actual percent of time at sea was calculated using all members of a rating, whether or not they held NECs subject to special sea/shore rotation requirements. The prescribed percent of time at sea, in contrast, applies only to those members of a rating who do not hold such NECs. Second, because of the way projected rotation dates (PRDs) are assigned, prescribed and actual percents of time at sea are not strictly comparable. According to the Enlisted Transfer Manual [3, Article 3.061]: "[The] PRD is based on an individual's paygrade or projected paygrade . . . at the time orders are written and [on] the distributable community in which he/she will serve . . . . The PRD will not be affected by advancement or reduction in rate."

Depending on how quickly an individual is promoted, he may be serving a tour whose length was assigned one or more paygrades earlier. That is, the actual percent of time at sea for individuals in a given paygrade may reflect the prescribed sea/shore rotation ratios for that paygrade and lower paygrades. Despite this difference, comparing the prescribed percent of time at sea with the actual percent should provide useful information.

It should also be kept in mind that sea/shore rotation is a policy that applies to career personnel only, that is, those in their second or subsequent enlistment. Personnel are not normally reassigned during their first term; their PRD is supposed to coincide with their expiration of active obligated service (EAOS) date. First-term personnel are assigned to sea or shore duty based on the requirements for their rating, with priority given to filling requirements at sea [3, article 3.20].

Several patterns are apparent in table 1. First, within a rating, both the prescribed and the actual percents of time at sea tend to decline as paygrade rises. Second, for almost half of the ratings, the actual percent of time at sea (k) exceeds the prescribed percent of time at sea (k^*) in the lower paygrades (especially E-3 to E-5); the reverse is true in the higher paygrades. This pattern is found almost without exception in the most sea-intensive ratings, i.e., those with $k \geq .58$. Individuals in the lower paygrades in these ratings often spend 80 percent or more of their time at sea (on average).

Turning to the relationship between the prescribed percent of time at sea and the percent of billets at sea, two patterns emerge. First, for 29 ratings (out of 103), the proportion of billets at sea is below the set of values of k^* specified for the paygrades within the rating. These ratings are generally the less sea-intensive ones. Second, for 22 ratings, the proportion of billets at sea is above the range of the prescribed percent of time at sea. These ratings are generally in the more sea-intensive group.

To illustrate the problems caused by this discrepancy, consider the most and least sea-intensive ratings. At one extreme is the Operations Specialist (OS) rating. Current policy indicates a prescribed percent of time at sea for this rating ranging from 71 percent for E-3 to

46 percent for E-9. However, 79 percent of the billets for this rating[1] (8,870 out of 11,223) have sea/shore code 2, 3, 4, or 5. At the other extreme is the Musician (MU) rating, with a prescribed percent of time at sea of 50 percent but only 13 percent (108 out of 822) of its billets at sea.[2] The OS detailer would have difficulty filling all the sea billets for Operations Specialists while maintaining the prescribed rotation ratios; the MU detailer would have difficulty filling all the shore billets for Musicians.

According to the model in the previous section, when $k^* \neq C/R$, two outcomes are possible. Inventory can be kept to a minimum (R), in which case tour lengths will have to be altered from their prescribed values to keep all the billets filled. In this case, the actual percent of time at sea will deviate from the prescribed percent. Alternatively, prescribed rotation ratios can be achieved by maintaining an inventory in excess of requirements and assigning k^* percent of that inventory (as opposed to C/R percent) to sea duty.

The latter outcome is not a realistic possibility for Navy enlisted ratings for two reasons. First, it is difficult for ratings to maintain an inventory in excess of requirements. Although there are not formal limits on inventory for a particular rating, the relationship between inventory and requirements is closely monitored. A number of policies—such as adjusting the number of A-school entrants—are employed to keep inventory close to requirements. Second, the assignment process generally allocates personnel between sea and shore duty in proportion to the number of billets authorized for each type of duty (see [6]). That is, even if the number of people in a rating exceeded billets authorized for that rating, C/R percent of these people would be allocated to sea duty, not k^* percent.

Given this fact, it is not surprising to see in table 1 that, when the proportion of billets at sea is below (above) the range of prescribed percent of time at sea, the actual percent of time at sea is also below (above) this range. In general, there is more similarity between the average actual percent of time at sea and the proportion of billets at sea than there is between the actual and prescribed percents of time at sea. This implies that tour lengths (or number of tours) are being adjusted to keep requirements filled. The next section will consider whether this pattern applies to NECs as well.

APPLICATION TO NECs

The nature of the personnel distribution process makes it difficult for a rating to follow its rotation policy if the prescribed percent of time at sea differs from the percent of billets at sea. This need not be true for an NEC, however. Most NEC holders are assigned by rating rather than

1. Among the billets with known sea/shore code.
2. While the Tradevman (TD) rating is ostensibly even less sea-intensive than the Musician rating, it is not a good example because it is in the process of being phased out.

by NEC;[1] thus, extra NEC holders can be assigned to billets within their rating that have no NEC requirements. Even if the prescribed percent of time at sea does not equal the percent of billets at sea, an NEC that is part of a rating distribution community should be able to achieve the prescribed sea/shore rotation pattern by maintaining an inventory in excess of requirements (and a utilization rate less than 1).

The actual percent of time at sea has not been measured at the NEC level. Thus, it is not possible to compare actual and prescribed percents as was done for ratings. It is possible, however, to compare the percent of billets at sea with the prescribed percent of time at sea and to calculate the maximum utilization rate (i.e., the minimum inventory) that would allow the prescribed sea/shore rotation pattern to be achieved.

Before doing this, it will be useful to discuss some of the characteristics of NECs and the relationship between NECs and ratings. Most NECs are either Rating Series NECs or Special Series NECs [1, p.1]. Most Rating Series NECs have one primary source rating, which is used as a prefix for the NEC. NECs that have the same first two digits are generally associated with the same primary source rating. Some groups of Rating Series NECs do not have a rating prefix; these groups include:

- Fleet Ballistic Missile Weapons Systems Personnel (NECs 3303-3342)
- Nuclear Propulsion Plant Operators/Supervisors (3349-3396)
- Naval Aircrewmen (8201-8295)
- Aircraft Systems Maintenance Personnel (8300-8391)
- Defense Grouping (DG) NECs (9700-9780).

DG NECs are unique in that they are assigned only to nonrated personnel; they are used to identify the occupational area in which an individual will be trained.

Special Series NECs usually have many source ratings. The three major categories of Special Series NECs are:

- Special Series (Divers) (NECs 5301-5346)

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1. That is, they belong to rating distribution communities. Individuals possessing closed-loop and transitory NECs belong to NEC distribution communities; they are assigned by NEC rather than by rating. Currently, there are approximately 165 closed-loop NECs and 16 transitory NECs [3, chapter 1]. In 1987, they accounted for 22 percent of NEC requirements and 19 percent of the NEC inventory.

- Special Series (General) (9501-9598)
- Special Series (Training Program) (9901).

A Special Series NEC cannot be an individual's primary NEC, and it cannot be the primary NEC (PNEC) for a billet.

Table 2 lists the number of billets and percent of billets at sea for NEC groups and their corresponding source ratings. The definitions of NEC groups and source ratings come from the NEC manual [1]; the other information is from the November 1985 Enlisted Billet File. Billets were classified by secondary NEC (SNEC) if SNEC was a Special Series NEC; otherwise, they were classified by PNEC.[1] Service ratings (e.g., STG or OTA) were included with their corresponding general ratings (ST, OT) in the classification of billets by rating. For those NEC groups with no rating prefix, "Number of Billets: Rating" is blank, and "Percent of Billets at Sea: Rating" is the range for the source ratings listed in the footnotes. For the Special Series NECs, both these columns are blank.

It is interesting to note the wide variation across ratings in the number of NECs and the percent of billets with NEC requirements. At one extreme are ratings with no associated NECs (i.e., ratings that are not primary source ratings); at the other extreme are ratings with over 50 associated NECs. Overall, about 44 percent of Planned Authorizations had one or more NECs required.

Table 2 can be used to compare the percent of billets at sea for an NEC group and its primary source rating. There are 59 groups for which this comparison can be made. In 44 cases, the sea intensity of the billets with NEC requirements is higher than the sea intensity for the rating as a whole. This is true as well when all NECs are compared with all ratings. That is, a billet requiring NECs is more likely to involve skills that are needed at sea than is a billet with no NEC requirements.

Calculating I^*

Attention is now turned to calculation of I^* and u^* at the NEC level. Recall that this calculation involves comparing C/R (the percent of requirements at sea) with k^* (the prescribed percent of time at sea for individuals filling those requirements). Computation of C/R at the NEC level was straightforward. Computation of k^* was more complicated.

1. That is, for simplicity, only one NEC was counted per billet. About 6 percent of billets in the file required two NECs.

Table 2. Some comparisons between NECs and ratings

First two digits of NEC	Number of NECs	Primary source rating	Number of billets		Percent of billets at sea	
			NEC	Rating	NEC	Rating
01	9	BM	940	10,791	.65	.69
02	2	QM	27	4,453	.30	.75
03	17	OS	4,690	11,640	.90	.79
04	42	ST	4,541	9,300	.91	.65
06	10	OT	452	1,750	.28	.35
07	9	TM	1,007	3,940	.20	.60
08,09	19	GM	3,573	8,160	.85	.67
11	60	FC,FT	5,322	10,761	.89	.67
12	3	MN	139	598	.51	.41
14,15	123	ET	8,263	18,672	.66	.56
16	26	DS	2,218	2,875	.76	.55
17	15	EW	1,673	2,603	.90	.67
18	3	IM	292	678	.67	.63
19	2	OM	129	428	.71	.59
21	1	NC	647	1,842	.03	.31
22	1	PC	47	1,204	.19	.63
23	52	RM	8,216	17,484	.67	.59
25	5	YN	1,443	13,930	.54	.38
26	1	PN	188	7,538	.05	.38
27	19	DP	1,526	4,048	.24	.33
28	11	SK	2,032	9,737	.73	.56
31	6	SH	2,883	5,005	.76	.74
32	1	JO	486	966	.74	.45
33	40	– [a]	11,903	–	.92	.56-.74
35	4	MS	2,441	16,781	.52	.65
38	16	MU	720	840	.15	.13
39	5	IS	766	1,582	.57	.45
41	10	GS	1,708	2,859	.92	.68
42	10	MM	4,839	26,184	.87	.74
43	14	EN	1,701	8,488	.75	.66
45	12	BT	2,307	10,515	.89	.77
46	12	EM	1,370	13,474	.80	.69
47	31	IC	3,050	6,560	.86	.72
49	15	HT	2,954	12,025	.75	.73

a. Primary source ratings are EM, ET, FT, MM, and MT.

Table 2. (Continued)

First two digits of NEC	Number of NECs	Primary source rating	Number of billets		Percent of billets at sea	
			NEC	Rating	NEC	Rating
53	16	–[b]	3,528	–	.72	–
55	2	EA	162	402	.62	.51
56	5	CE	243	1,414	.68	.54
57	3	EO	176	2,005	.90	.57
58	2	CM	124	1,537	.69	.57
59	5	BU	376	2,888	.74	.58
60	2	SW	107	964	.64	.58
61	3	UT	228	1,318	.65	.54
63	1	AZ	571	4,213	.40	.44
64	17	AD	2,207	12,108	.30	.43
65	13	AX	1,156	2,129	.59	.45
66	75	AT	4,282	11,834	.57	.49
68	5	AO	672	7,116	.62	.59
69	2	AC	538	3,096	.59	.29
70	1	AB	414	6,703	.79	.68
71	24	AE	1,684	8,537	.55	.48
72	4	AM	873	17,283	.46	.49
73	2	PR	26	2,484	.46	.43
74	2	AG	515	1,500	.56	.43
75	2	TD	115	324	.01	.01
78	11	AW	2,571	3,895	.72.	50
79	31	AQ	1,013	2,884	.67	.49
80	1	AK	330	5,344	.35	.46
81	9	PH	664	1,810	.47	.47
82	31	–[c]	5,330	–	.58	.43-.59
83	32	–[c]	27,214	–	.59	.43-.59
84,85	35	HM	12,324	23,836	.41	.28
87	8	DT	1,047	3,199	.43	.28
91,92	98	CT	6,126	11,298	.35	.27
95	56	–[b]	34,961	–	.20	–
97	8	–[d]	25,352	–	.98	–
99	1	–[e]	3,689	–	.00	.56-.74
Total	1,113		223,111	502,857[f]	.61	.55[f]

b. Multiple source ratings.
c. Primary source ratings are AD, AE, AM, AO, and AT.
d. Entry Series NECs, for unrated personnel.
e. Primary source ratings are EM, MM, and ET.
f. For all ratings.

One complication arose because prescribed sea and shore tours generally vary by paygrade, whereas a single value of k^* was needed for each NEC.[1] A second complication arose in deciding which sea and shore tours to use in the calculation of k^*. For an NEC with a single primary source rating or an NEC with its own sea and shore tours, only one set of tour lengths was needed to calculate k^*. k^* for such an NEC was computed as a weighted average across paygrades, with the weight for a paygrade equal to the fraction of the NEC's requirements in that paygrade. For an NEC with multiple source ratings, the tour lengths corresponding to each rating found in the requirements data were used to calculate k^* by rating and paygrade. k^* for the NEC was then computed as a weighted average across ratings and paygrades, with the weight for a rating-paygrade category equal to the fraction of the NEC's requirements falling in that category.

Table 3 shows the distribution of NECs and billets classified by type of sea/shore rotation. Although almost 70 percent of the NECs had a single source rating, these NECs accounted for less than half of requirements. NECs with multiple source ratings accounted for one-third of requirements, even though only 12 percent of NECs fell in this category. The 120 NECs not subject to sea/shore rotation were not included in the calculation of I^*, since they have no k^* values.

Once k^* was calculated for each NEC, k^* and C/R were compared by NEC. The following values were then calculated:

- I^*, the inventory needed to fill all requirements for the NEC while following prescribed rotation policy
- I^*/R, the ratio of this inventory to requirements
- u^*, the maximum utilization rate achievable if all billets were filled and prescribed rotation policy followed.

The formulas for these variables depend on whether the fraction of billets at sea is greater than or less than the prescribed fraction of time at sea. Table 4 shows the formulas for the two cases, as well as the number of NECs and billets to which each formula was applied. (Recall that I^*/R is the inverse of u^*.) For about 60 percent of the NECs and billets, the percent of billets at sea was greater than the average prescribed percent of time at sea for people filling those billets. Only one NEC had k^* equal to C/R.

1. One way to calculate I^* would be to compare C/R to k^* by NEC and paygrade. However, since substitution among paygrades in the filling of requirements is fairly common, this approach would lead to an overstatement of I^*.

Table 3. NEC requirements by type of sea/shore rotation

	NECs		Billets	
	Number	Percent	Number	Percent
Not subject to sea/shore rotation	120	11	32,324	14
Own sea and shore tours	89	8	23,913	11
Single source rating	770	69	93,211	42
Multiple source ratings	134	12	73,663	33
Total	1,113	100	223,111	100

Table 4. Formulas for I^* and u^*

	$k^* < C/R$	$k^* > C/R$
I^*	C/k^*	$S/(1 - k^*)$
u^*	$k^*/(C/R)$	$(1 - k^*)/(1 - C/R)$
Number of NECs	591	401
Number of billets	114,591	190,785

The appendix contains the values of C/R, k^*, u^*, I^*/R, and I^* for each NEC. Table 5 contains the distribution of u^* values across NECs. The minimum value of u^* was .286 and the maximum value was 1. About two-thirds of the u^* values fell between .5 and .8.

Besides looking at individual values of u^* and I^*/R, it would be useful to have average values of these variables for all NECs combined. An aggregate value of I^* was calculated by summing the I^* values for individual NECs. The average value of I^*/R was then calculated as the ratio of aggregate I^* to the total number of billets requiring NECs; the average value of u^* is the inverse of this ratio. The average value of I^*/R was found to be 1.56, implying an average utilization rate of .64. That is, in the aggregate, the NEC inventory needed to keep all requirements filled was estimated to be about 56 percent above requirements.

Table 5. Distribution of u^* values by NEC

Range	Number	Percent
$.10 \leq u^* < .20$	0	0
$.20 \leq u^* < .30$	2	0.2
$.30 \leq u^* < .40$	12	1.2
$.40 \leq u^* < .50$	88	8.9
$.50 \leq u^* < .60$	213	21.5
$.60 \leq u^* < .70$	251	25.3
$.70 \leq u^* < .80$	206	20.7
$.80 \leq u^* < .90$	129	13.0
$.90 \leq u^* < 1.0$	91	9.2
$u^* = 1.0$	1	0.1
Total	993	100.0

The aggregate I^* is the inventory of NECs needed to fill all NEC requirements if prescribed rotation policy is followed. It is also the maximum number of people that would be needed to fill these requirements, that is, the number needed if one person held each of the NECs required. Because only one NEC requirement was counted per billet, it would not be possible to reduce I^* by allowing individuals to use more than one NEC at a time.[1] I^* could be reduced, however, if individuals held more than one of the NECs needed and used one of them at sea and another ashore.

Calculating the Inventory Needed Under Actual Rotation Ratios

Table 1 presented evidence that actual sea and shore tours do not always equal their prescribed lengths. If this is true for people with NECs, the number of NEC holders needed to keep requirements filled under actual rotation ratios will differ from the number needed under prescribed ratios. To see how different the two numbers might be, an estimate of the actual

1. A billet can require two NECs, and an individual can use two NECs at a time. Dual NEC requirements and assignments complicate the calculation of I^* ; however, in practice, they are not that common. In 1987, 6 percent of billets required two NECs and 4 percent of individuals were assigned to two NECs.

percent of time at sea for NEC holders ($\hat{k}$) was compared to the percent of requirements at sea (C/R) for each NEC. The inventory resulting from this comparison might represent a more realistic estimate of the number of NEC holders the Navy needs.

Estimates of the actual percent of time at sea for NEC holders were based on percents reported in [5] for ratings and paygrades (see table 1). $\hat{k}$ for an NEC was computed as a weighted average of the k values for the rating(s) and paygrades found in the requirements for that NEC. Implicit in this calculation are the assumptions that (1) people filling the billets have the ratings and paygrades specified in the requirements, and (2) within a rating and paygrade, people with NECs spend the same fraction of time at sea as people without NECs.[1]

After comparing $\hat{k}$ to C/R, formulas similar to those in table 4 (but with $\hat{k}$ replacing k^*) were used to compute I, I/R, and u. These values represent the inventory, ratio of inventory to requirements, and utilization rate when the actual percent of time at sea equals the average found over the period January 1982 to June 1986. Table 6 shows the resulting distribution of u across NECs.

In the comparison between k and k^* for ratings, it was noted that there was more similarity between the actual percent of time at sea and the proportion of billets at sea than there was between the actual and prescribed percents of time at sea. This might lead one to expect that the inventory needed to fill NEC requirements under actual rotation ratios (that is, the inventory that results from comparing $\hat{k}$ to C/R) would be smaller than the inventory needed to fill those requirements under prescribed ratios (I^*). In other words, u might be expected, in general, to be higher than u^*. However, comparison of tables 5 and 6 reveals that the distribution of u is not very different from the distribution of u^*. Moreover, the average value of u for all NECs (.65) is close to the average value of u^* (.64).

Closer examination of the data was undertaken in an attempt to account for the similarity between the distributions of u and u^*. Interestingly, the estimated actual percent of time at sea was less than the prescribed percent for almost 75 percent of the NECs; that is, most NECs were predicted to be less sea-intensive in practice than in theory. However, $k < k^*$ does not necessarily imply $u < u^*$; the outcome depends on whether k^* is greater than or less than C/R. It turned out that $u < u^*$ for about half the NECs and that $u > u^*$ for the other half ($u = u^*$ for one NEC).

1. The first assumption is not completely realistic, since there is some substitution among paygrades in the filling of requirements (although individuals generally have the required ratings). It is not known how correct the second assumption is. Within rating distribution communities, individuals with NECs should spend the same fraction of time at sea as individuals without NECs, although, in practice, they may not. People with closed-loop and transitory NECs probably spend a different fraction of time at sea than people within the same ratings who do not have such NECs.

Table 6. *Distribution of u values by NEC*

Range	Number	Percent
$.10 \leq u < .20$	2	0.2
$.20 \leq u < .30$	3	0.3
$.30 \leq u < .40$	16	1.6
$.40 \leq u < .50$	82	8.3
$.50 \leq u < .60$	218	22.0
$.60 \leq u < .70$	205	20.6
$.70 \leq u < .80$	205	20.6
$.80 \leq u < .90$	145	14.6
$.90 \leq u < 1.0$	117	11.8
$u = 1.0$	0	0
Total	993	100.0

One question that was investigated was the range of values of *C/R* (the percent of billets at sea) within NEC groups, which are proxies for ratings. Because sea and shore tours are generally determined by rating, values of k^* (or k) should be similar for NECs in the same group (i.e., with the same first two digits). It was found, however, that within many NEC groups, there is a wide range of values of *C/R*. In 18 out of 70 groups, *C/R* varies from 0 (no billets at sea) to 1 (all billets at sea). Because of the large variation in the percent of billets at sea, the actual percent of time at sea is likely to be a better match to *C/R* than the prescribed percent of time at sea for some NECs, but a worse match for others.

The wide variation in the percent of billets at sea within NEC groups implies that within a rating, there are often both sea-intensive and shore-intensive NECs. It may be reasonable, therefore, for an individual to possess both a sea-intensive and a shore-intensive NEC. As mentioned earlier, having people use one NEC at sea and another ashore is one way of reducing the number of people needed to fill aggregate NEC requirements.

CONCLUSION

This research memorandum presents a simple model of the relationship between the sea/shore rotation policy for an enlisted skill community and the utilization rate for that skill. The basic conclusion of the model is: if the prescribed percent of time at sea does not equal the percent of billets at sea, then either the inventory needed to fill all the billets while achieving the desired rotation pattern will exceed requirements, or actual sea and shore tours will have to be adjusted to keep all the billets filled. The model can be used to calculate the number of people needed to keep requirements filled while maintaining the prescribed rotation pattern. The ratio of requirements to this inventory can be thought of as the maximum utilization rate achievable for the community if rotation policy is followed.

The model was first applied to ratings. For each rating, the prescribed percent of time at sea was compared to the actual percent of time at sea and the percent of billets at sea. The conclusion was that, in general, tour lengths (or number of tours) were being adjusted to keep the requirements within a rating filled. This conclusion makes sense, because, for ratings, it usually is not possible to maintain an inventory in excess of requirements.

The model was then applied to NECs. First, the prescribed percent of time at sea was compared to the percent of billets at sea for each NEC. The maximum utilization rate achievable while following prescribed rotation policy, and the corresponding inventory, were calculated. In the aggregate, the number of NEC holders needed to keep all requirements filled was estimated to be about 56 percent above requirements, implying an average NEC utilization rate of .64.

To estimate the implications of actual (as opposed to prescribed) rotation patterns for the NEC inventory, an estimate of the actual percent of time at sea was compared to the percent of billets at sea for each NEC. The results of this comparison were surprisingly similar to those from the comparison using prescribed percents. In the aggregate, the ratio of inventory to requirements was 1.54, implying an average NEC utilization rate of .65.

Sea/shore rotation is only one of several factors affecting NEC utilization. This paper has shown that, even if there were no other constraints on utilization, strict application of rotation policy could lead to utilization rates well below 1.

REFERENCES

[1] Department of the Navy, Bureau of Naval Personnel, NAVPERS 18068E, *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards: Section II, Navy Enlisted Classifications*, April 1987 (237679)[1]

[2] CNA Research Memorandum 88-22, *Trends in Navy Enlisted Classification (NEC) Inventories and Their Utilization*, by Alan J. Marcus, Marianne Bowes, and Patricia E. Byrnes, Feb 1988 (27880022)

[3] Department of the Navy, Bureau of Naval Personnel, NAVPERS 15909C, Change No. 24, *Enlisted Transfer Manual*, 30 Jan 1987

[4] CNA Memorandum 82-1372, *The Optimal Sea/Shore Rotation Ratio*, by Matthew S. Goldberg, Sep 1982 (05821372)

[5] CNA Research Memorandum 86-251, *Recent Sea Duty for Rotation of Enlisted Personnel*, by Timothy W. Cooke and Kevin B. Garvey, Oct 1986 (27860251)

[6] CNA Research Memorandum 87-216, *Enlisted Personnel Distribution*, by Marianne Bowes, Oct 1987 (27870216)

1. Numbers in parentheses are CNA internal control numbers.

APPENDIX

SUPPORTING DATA

APPENDIX

SUPPORTING DATA

Table A-1 contains values of u^* and I^*/R, as well as the values of C/R and k^* used to calculate them, for each NEC.

Table A-1. u^* and I^* by NEC(a)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
0107	BM	71	15	0.826	0.645	0.781	1.280	110.1
0108	BM	9	0	1.000	0.648	0.648	1.542	13.9
0114	BM	39	7	0.848	0.657	0.775	1.290	59.3
0161	BM	50	175	0.222	0.570	0.553	1.808	406.8
0162	BM	27	111	0.196	0.608	0.487	2.052	283.1
0163	BM	8	2	0.800	0.553	0.691	1.448	14.5
0164	BM	348	15	0.959	0.704	0.734	1.362	494.4
0165	BM	46	5	0.902	0.570	0.632	1.583	80.7
0167	BM	12	0	1.000	0.560	0.560	1.786	21.4
0215	QM	8	15	0.348	0.553	0.685	1.460	33.6
0216	QM	0	4	0.000	0.556	0.444	2.250	9.0
0301	OS	695	4	0.994	0.689	0.693	1.442	1008.1
0311	OS	79	0	1.000	0.699	0.699	1.430	113.0
0312	OS	549	4	0.993	0.697	0.702	1.425	788.1
0313	OS	158	25	0.863	0.704	0.816	1.226	224.3
0314	OS	1	0	1.000	0.645	0.645	1.550	1.6
0315	OS	21	1	0.955	0.699	0.732	1.366	30.1
0316	OS	196	15	0.929	0.708	0.762	1.313	277.0
0317	OS	1341	192	0.875	0.690	0.788	1.268	1944.3
0318	OS	326	27	0.924	0.704	0.762	1.312	463.2
0319	OS	120	31	0.795	0.613	0.771	1.296	195.8
0321	OS	309	6	0.981	0.704	0.717	1.394	439.0
0322	OS	21	1	0.955	0.641	0.672	1.489	32.8
0331	OS	59	127	0.317	0.704	0.434	2.303	428.4
0332	OS	30	1	0.968	0.691	0.715	1.400	43.4
0333	OS	0	19	0.000	0.691	0.309	3.240	61.6
0341	OS	286	33	0.897	0.592	0.660	1.515	483.2
0342	OS	13	0	1.000	0.666	0.666	1.501	19.5
0402	STG,ST	148	34	0.813	0.604	0.742	1.347	245.2
0403	STG	36	0	1.000	0.615	0.615	1.625	58.5
0404	STG	19	0	1.000	0.667	0.667	1.500	28.5
0406	STG	1	0	1.000	0.538	0.538	1.857	1.9
0407	STG	3	1	0.750	0.587	0.783	1.278	5.1
0408	STG	47	7	0.870	0.607	0.697	1.435	77.5
0409	STS	4	1	0.800	0.661	0.827	1.210	6.0
0412	STS	83	12	0.874	0.657	0.752	1.330	126.4
0413	STG	0	1	0.000	0.571	0.429	2.333	2.3
0416	STG,STS,ST	49	24	0.671	0.624	0.930	1.075	78.5
0421	STS,ST	346	19	0.948	0.657	0.694	1.442	526.3
0422	STS,ST	453	57	0.888	0.642	0.723	1.383	705.4
0424	STS,ST	30	18	0.625	0.647	0.942	1.061	50.9
0426	STS,ST	86	19	0.819	0.635	0.776	1.289	135.3
0427	STS,ST	51	20	0.718	0.643	0.895	1.117	79.3
0428	STS,ST	575	11	0.981	0.652	0.665	1.505	881.7

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
0431	STG	68	12	0.850	0.646	0.760	1.316	105.3
0434	STG	194	13	0.937	0.646	0.690	1.450	300.2
0435	STG	15	1	0.938	0.627	0.668	1.496	28.4
0436	STG,ST	9	0	1.000	0.624	0.624	1.602	14.4
0437	STG	68	1	0.986	0.638	0.647	1.545	106.6
0438	STG	22	1	0.957	0.629	0.658	1.520	35.0
0440	STG,ST	107	1	0.991	0.560	0.565	1.769	191.0
0441	STG	72	0	1.000	0.667	0.667	1.500	108.0
0445	STG	588	23	0.962	0.663	0.688	1.453	887.5
0446	STG	38	2	0.950	0.667	0.702	1.425	57.0
0447	STG	148	21	0.876	0.652	0.744	1.344	227.1
0449	STG	58	10	0.853	0.651	0.763	1.311	89.1
0452	STG	32	3	0.914	0.617	0.675	1.482	51.9
0454	STG	122	14	0.897	0.623	0.695	1.439	195.8
0456	STG	137	10	0.932	0.662	0.710	1.408	206.9
0457	STG	120	28	0.811	0.626	0.772	1.296	191.8
0459	STG	88	11	0.889	0.636	0.715	1.399	138.5
0472	STG,ST	7	2	0.778	0.549	0.706	1.417	12.8
0473	STG,ST	19	9	0.679	0.556	0.820	1.220	34.2
0474	STG,ST	75	7	0.915	0.562	0.614	1.628	133.5
0475	STG,ST	55	3	0.948	0.563	0.594	1.683	97.6
0477	STG,ST	37	5	0.881	0.564	0.640	1.561	65.6
0482	STG,ST	15	0	1.000	0.558	0.558	1.791	26.9
0483	STG,ST	74	15	0.831	0.546	0.656	1.524	135.6
0484	STG,ST	0	1	0.000	0.571	0.429	2.333	2.3
0492	STG,ST	21	1	0.955	0.559	0.586	1.706	37.5
0612	OTA	10	61	0.141	NA	NA	NA	NA
0613	OTA	30	1	0.968	NA	NA	NA	NA
0614	OTA	0	129	0.000	NA	NA	NA	NA
0619	OTA	17	28	0.378	NA	NA	NA	NA
0623	OTM	7	0	1.000	NA	NA	NA	NA
0624	OTM	0	10	0.000	NA	NA	NA	NA
0626	OTM	44	63	0.411	NA	NA	NA	NA
0627	OTM	4	6	0.400	NA	NA	NA	NA
0628	OTM	11	14	0.440	NA	NA	NA	NA
0629	OTM	3	14	0.176	NA	NA	NA	NA
0718	TM(b)	34	28	0.548	0.499	0.910	1.099	68.2
0719	TM(b)	40	7	0.851	0.479	0.562	1.778	83.6
0720	TM(b)	0	6	0.000	0.490	0.510	1.960	13.7
0721	TM(b)	62	8	0.886	0.500	0.565	1.771	124.0
0746	TM(b)	41	225	0.154	0.495	0.597	1.676	445.7
0747	TM(b)	13	69	0.159	0.476	0.622	1.607	131.8
0748	TM(b)	8	344	0.023	0.497	0.515	1.943	683.8
0749	TM(b)	0	118	0.000	0.429	0.571	1.750	206.5
0771	TM(b)	2	0	1.000	0.500	0.500	2.000	6.0
0811	GMG,GMM,GM	2	2	0.500	0.625	0.750	1.333	5.3

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
0812	GMG,GMM,GM	13	35	0.271	0.630	0.508	1.970	94.5
0871	GMG,GMM	192	8	0.960	0.676	0.704	1.420	284.0
0872	GMG,GMM	80	2	0.976	0.656	0.672	1.487	122.0
0873	GMG,GMM	4	8	0.333	0.649	0.527	1.898	22.8
0875	GMG,GMM	130	0	1.000	0.679	0.679	1.472	191.4
0876	GMG,GMM	488	50	0.907	0.659	0.726	1.377	740.8
0877	GMG,GMM,GM	319	27	0.922	0.659	0.715	1.399	484.1
0878	GMG,GMM	117	33	0.780	0.665	0.852	1.173	176.0
0891	GMG,GMM	581	46	0.927	0.646	0.697	1.434	899.3
0893	GMG,GMM,GM	111	4	0.965	0.652	0.675	1.481	170.4
0926	GMG,GMM,GM	216	151	0.589	0.628	0.904	1.106	406.0
0981	GMG,GMM,GM	0	2	0.000	0.607	0.393	2.545	5.1
0986	GMG,GMM,GM	364	109	0.770	0.643	0.836	1.197	566.0
0987	GMG,GMM	97	15	0.866	0.644	0.743	1.345	150.6
0988	GMG,GMM	65	6	0.915	0.638	0.697	1.435	101.9
0989	GMG,GMM	81	4	0.953	0.639	0.670	1.491	126.8
0990	GMG,GMM	4	0	1.000	0.667	0.667	1.500	6.0
0991	GMG,GMM	178	29	0.860	0.645	0.750	1.333	275.9
1102	FC	334	25	0.930	0.559	0.601	1.665	597.6
1106	FC	36	26	0.581	0.567	0.976	1.024	63.5
1107	FC	38	27	0.585	0.571	0.977	1.023	66.5
1108	FC	12	20	0.375	0.554	0.714	1.400	44.8
1109	FC	52	14	0.788	0.511	0.648	1.542	101.8
1111	FC	162	12	0.931	0.571	0.613	1.632	283.9
1112	FC	51	0	1.000	0.569	0.569	1.759	89.7
1113	FC	50	6	0.893	0.571	0.640	1.562	87.5
1114	FC	18	4	0.818	0.571	0.698	1.432	31.5
1115	FC	16	1	0.941	0.571	0.607	1.647	28.0
1116	FC	25	4	0.862	0.571	0.663	1.509	43.7
1117	FC	3	1	0.750	0.571	0.762	1.312	5.2
1120	FC	0	2	0.000	0.571	0.429	2.333	4.7
1123	FC	95	1	0.990	0.563	0.568	1.759	168.9
1124	FC	2	1	0.667	0.571	0.857	1.167	3.5
1125	FC	206	23	0.900	0.560	0.622	1.607	367.9
1126	FC	53	3	0.946	0.568	0.600	1.667	93.4
1127	FC	797	36	0.957	0.569	0.594	1.683	1401.9
1128	FC	9	2	0.818	0.571	0.698	1.432	15.7
1129	FC	3	1	0.750	0.571	0.762	1.312	5.2
1130	FC	73	8	0.901	0.556	0.617	1.620	131.2
1131	FC	81	19	0.810	0.506	0.625	1.599	159.9
1132	FC	115	11	0.913	0.569	0.623	1.605	202.3
1133	FC	146	6	0.961	0.570	0.594	1.684	255.9
1134	FC	85	0	1.000	0.564	0.564	1.773	150.7
1135	FC	60	10	0.857	0.571	0.667	1.500	105.0
1137	FC	31	4	0.886	0.567	0.641	1.561	54.6
1138	FC	232	27	0.896	0.566	0.632	1.582	409.8

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
1140	FC	0	1	0.000	0.571	0.429	2.333	2.3
1142	FC	13	3	0.813	0.567	0.698	1.433	22.9
1146	FC	115	29	0.799	0.566	0.709	1.411	203.2
1147	FC	1	1	0.500	0.500	1.000	1.000	2.0
1148	FC	282	28	0.910	0.564	0.620	1.613	500.0
1149	FC	38	5	0.884	0.568	0.643	1.556	66.9
1150	FC	14	2	0.875	0.522	0.597	1.675	26.8
1151	FC	26	0	1.000	0.571	0.571	1.750	45.5
1152	FC	14	4	0.778	0.524	0.673	1.485	26.7
1153	FC	57	8	0.877	0.526	0.600	1.666	108.3
1154	FC	57	12	0.826	0.530	0.642	1.559	107.5
1155	FC	55	8	0.873	0.508	0.582	1.719	108.3
1156	FC	1	0	1.000	0.500	0.500	2.000	2.0
1157	FC	30	2	0.938	0.502	0.536	1.867	59.7
1158	FC	5	0	1.000	0.514	0.514	1.944	9.7
1162	FC	22	0	1.000	0.571	0.571	1.750	38.5
1163	FC	323	23	0.934	0.570	0.611	1.637	566.3
1166	FC	157	12	0.929	0.571	0.615	1.627	275.0
1167	FC	8	2	0.800	0 571	0.714	1.400	14.0
1168	FC	66	4	0.943	0.571	0.606	1.650	115.5
1176	FTG,FT	213	49	0.813	0.568	0.699	1.430	374.7
1181	FTG,FT	7	3	0.700	0.550	0.786	1.273	12.7
1182	FTG,FT	39	13	0.750	0.571	0.762	1.312	68.2
1183	FC	11	0	1.000	0.571	0.571	1.750	19.2
1188	FC	102	14	0.879	0.571	0.649	1.540	178.7
1189	FC	108	4	0.964	0.571	0.593	1.687	189.0
1191	FTG,FT	30	20	0.600	0.570	0.950	1.053	52.6
1192	FTG,FT	9	0	1.000	0.571	0.571	1.750	15.7
1193	FTG,FT	27	3	0.900	0.564	0.627	1.595	47.8
1195	FTG	44	4	0.917	0.571	0.623	1.604	77.0
1196	FTG,FT	84	10	0.894	0.571	0.639	1.564	147.0
1197	FTG,FT	7	14	0.333	0.565	0.653	1.531	32.2
1200	MN	25	31	0.446	NA	NA	NA	NA
1201	MN	32	17	0.653	NA	NA	NA	NA
1202	MN	14	20	0.412	NA	NA	NA	NA
1403	ET	48	43	0.527	0.575	0.899	1.112	101.2
1411	ET	2	7	0.222	0.497	0.647	1.546	13.9
1412	ET	18	27	0.400	0.530	0.784	1.276	57.4
1413	ET	57	115	0.331	0.571	0.642	1.557	267.8
1414	ET	11	16	0.407	0.576	0.716	1.396	37.7
1415	ET	79	126	0.385	0.577	0.689	1.452	297.6
1417	ET	46	40	0.535	0.569	0.926	1.079	92.8
1418	ET	17	22	0.436	0.587	0.732	1.365	53.2
1419	ET	17	0	1.000	0.466	0.466	2.144	36.4
1420	ET	276	21	0.929	0.533	0.574	1.743	517.7
1422	ET	55	5	0.917	0.591	0.645	1.551	93.1

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
1423	ET	107	38	0.738	0.575	0.779	1.283	186.1
1425	ET	125	29	0.812	0.571	0.704	1.421	218.9
1427	ET	131	41	0.762	0.575	0.754	1.326	228.0
1428	ET	100	16	0.862	0.587	0.681	1.469	170.4
1431	ET	441	51	0.896	0.571	0.638	1.569	771.8
1432	ET	11	32	0.256	0.559	0.592	1.689	72.6
1434	ET	26	117	0.182	0.588	0.504	1.986	284.0
1435	ET	69	60	0.535	0.556	0.955	1.047	135.0
1436	ET	419	47	0.899	0.573	0.637	1.569	731.1
1437	ET	1	3	0.250	0.564	0.582	1.718	6.9
1438	ET	417	122	0.774	0.590	0.763	1.311	706.6
1439	ET	8	34	0.190	0.576	0.524	1.909	80.2
1441	ET	21	60	0.259	0.577	0.571	1.753	142.0
1442	ET	16	47	0.254	0.596	0.542	1.844	116.2
1443	ET	18	10	0.643	0.578	0.899	1.112	31.1
1444	ET	1	12	0.077	0.602	0.431	2.318	30.1
1445	ET	170	44	0.794	0.600	0.756	1.324	283.2
1446	ET	26	16	0.619	0.603	0.974	1.026	43.1
1448	ET	15	50	0.231	0.581	0.544	1.837	119.4
1449	ET	22	64	0.256	0.572	0.575	1.740	149.7
1451	ET	28	19	0.596	0.574	0.963	1.038	48.8
1452	ET	65	5	0.929	0.588	0.633	1.580	110.6
1453	ET	291	31	0.904	0.592	0.655	1.528	491.9
1454	ET	58	9	0.866	0.510	0.589	1.697	113.7
1456	ET	6	32	0.158	0.572	0.508	1.968	74.8
1457	ET	12	4	0.750	0.548	0.730	1.370	21.9
1458	ET	9	24	0.273	0.598	0.553	1.810	59.7
1461	ET	28	52	0.350	0.549	0.694	1.442	115.3
1462	ET	0	9	0.000	0.464	0.536	1.867	16.8
1463	ET	17	6	0.739	0.578	0.782	1.278	29.4
1464	ET	21	21	0.500	0.581	0.838	1.194	50.1
1466	ET	6	0	1.000	0.610	0.610	1.640	9.8
1467	ET	0	4	0.000	0.619	0.381	2.625	10.5
1468	ET	6	0	1.000	0.584	0.584	1.713	10.3
1469	ET	0	1	0.000	0.481	0.519	1.929	1.9
1470	ET	17	7	0.708	0.573	0.809	1.236	29.7
1471	ET	47	60	0.439	0.585	0.741	1.350	144.5
1472	ET	51	34	0.600	0.582	0.970	1.031	87.6
1473	ET	74	12	0.860	0.588	0.684	1.463	125.8
1474	ET	0	2	0.000	0.474	0.526	1.899	3.8
1476	ET	4	5	0.444	0.478	0.940	1.064	9.6
1477	ET	73	2	0.973	0.579	0.595	1.681	126.1
1478	ET	0	3	0.000	0.506	0.494	2.026	6.1
1481	ET	2	8	0.200	0.575	0.531	1.882	18.8
1482	ET	0	13	0.000	0.536	0.464	2.156	28.0
1483	ET	0	13	0.000	0.579	0.421	2.377	30.9

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k•	u(k•)	I(k•)/R	I(k•)
1484	ET	0	6	0.000	0.500	0.500	2.000	12.0
1485	ET	2	9	0.182	0.500	0.611	1.637	18.0
1491	ET	44	16	0.733	0.575	0.785	1.274	76.5
1492	ET	1	0	1.000	0.591	0.591	1.692	1.7
14AA	ET(SS)	8	2	0.800	0.575	0.718	1.392	13.9
14AB	ET(SS)	44	0	1.000	0.589	0.589	1.698	74.7
14AD	ET(SS)	6	1	0.857	0.611	0.713	1.403	9.8
14AE	ET(SS)	1	0	1.000	0.538	0.538	1.857	1.9
14BA	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14BB	ET(SS)	2	0	1.000	0.652	0.652	1.533	3.1
14CA	ET(SS)	27	14	0.659	0.540	0.821	1.218	50.0
14CB	ET(SS)	8	0	1.000	0.586	0.586	1.706	13.6
14CF	ET(SS)	3	0	1.000	0.528	0.528	1.895	5.7
14CG	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14CJ	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14DA	ET(SS)	3	1	0.750	0.529	0.705	1.418	5.7
14DB	ET(SS)	19	2	0.905	0.598	0.661	1.513	31.8
14DC	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14DE	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14DK	ET(SS)	0	1	0.000	0.538	0.462	2.167	2.2
14EM	ET(SS)	5	0	1.000	0.579	0.579	1.727	8.6
14FA	ET(SS)	14	5	0.737	0.570	0.773	1.294	24.6
14HA	ET(SS)	6	2	0.750	0.519	0.692	1.444	11.6
14HB	ET(SS)	13	0	1.000	0.575	0.575	1.739	22.6
14HC	ET(SS)	0	7	0.000	0.533	0.467	2.141	15.0
14HD	ET(SS)	6	0	1.000	0.576	0.576	1.737	10.4
14HE	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14NA	ET(SS)	1	0	1.000	0.583	0.583	1.714	1.7
14PA	ET(SS)	1	0	1.000	0.538	0.538	1.857	1.9
14PB	ET(SS)	2	0	1.000	0.538	0.538	1.857	3.7
14PC	ET(SS)	7	0	1.000	0.567	0.567	1.763	12.3
14QC	ET(SS)	5	0	1.000	0.571	0.571	1.750	8.7
14RA	ET(SS)	0	2	0.000	0.519	0.481	2.080	4.2
14RC	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14RD	ET(SS)	9	0	1.000	0.579	0.579	1.729	15.6
14SA	ET(SS)	9	3	0.750	0.537	0.717	1.396	16.7
14SC	ET(SS)	27	0	1.000	0.579	0.579	1.729	46.7
14SF	ET(SS)	16	0	1.000	0.618	0.618	1.618	25.9
14TA	ET(SS)	0	2	0.000	0.519	0.481	2.080	4.2
14TB	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14TC	ET(SS)	0	1	0.000	0.500	0.500	2.000	2.0
14TG	ET(SS)	17	1	0.944	0.584	0.619	1.616	29.1
14ZA	ET(SS)	0	1	0.000	0.538	0.462	2.167	2.2
14ZC	ET(SS)	1	0	1.000	0.583	0.583	1.714	1.7
14ZH	ET(SS)	0	1	0.000	0.538	0.462	2.167	2.2
14ZJ	ET(SS)	1	0	1.000	0.538	0.538	1.857	1.9

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k•	u(k•)	I(k•)/R	I(k•)
1502	ET	70	11	0.864	0.570	0.659	1.517	122.9
1503	ET	143	27	0.841	0.516	0.613	1.632	277.4
1504	ET	21	14	0.600	0.540	0.900	1.112	38.9
1507	ET	18	3	0.857	0.594	0.693	1.443	30.3
1508	ET	36	0	1.000	0.539	0.539	1.854	66.7
1509	ET	2	0	1.000	0.464	0.464	2.154	4.3
1510	ET	0	1	0.000	0.464	0.536	1.867	1.9
1511	ET	2	0	1.000	0.550	0.550	1.817	3.6
1516	ET	298	19	0.940	0.541	0.576	1.737	550.5
1522	ET	54	27	0.667	0.570	0.854	1.170	94.8
1523	ET	23	4	0.852	0.555	0.652	1.534	41.4
1572	ET	437	51	0.895	0.582	0.650	1.538	750.4
1573	ET	1	18	0.053	0.532	0.494	2.025	38.5
1574	ET	2	44	0.043	0.548	0.472	2.117	97.4
1576	ET	36	0	1.000	0.552	0.552	1.812	65.2
1577	ET	14	11	0.560	0.515	0.919	1.088	27.2
1578	ET	0	74	0.000	0.549	0.451	2.219	164.2
1579	ET	9	149	0.057	0.564	0.463	2.161	341.4
1580	ET	12	110	0.098	0.562	0.486	2.057	250.9
1588	ET	389	464	0.456	0.558	0.812	1.232	1050.8
1614	DS	17	0	1.000	0.598	0.598	1.673	28.4
1615	DS	117	36	0.765	0.494	0.646	1.548	236.9
1616	DS	107	47	0.695	0.576	0.829	1.207	185.8
1623	DS	115	42	0.732	0.579	0.791	1.265	198.5
1624	DS	1	0	1.000	0.605	0.605	1.652	1.7
1634	DS	22	43	0.338	0.585	0.628	1.593	103.5
1635	DS	22	1	0.957	0.584	0.611	1.638	37.7
1636	DS	30	18	0.625	0.576	0.922	1.085	52.1
1637	DS	185	39	0.826	0.566	0.686	1.458	326.6
1638	DS	59	26	0.694	0.565	0.814	1.229	104.5
1645	DS	0	11	0.000	0.583	0.417	2.396	26.4
1647	DS	0	22	0.000	0.579	0.421	2.378	52.3
1653	DS	107	7	0.939	0.578	0.616	1.623	185.0
1655	DS	58	5	0.921	0.585	0.636	1.573	99.1
1664	DS	34	2	0.944	0.581	0.615	1.626	58.5
1665	DS	116	24	0.829	0.592	0.715	1.399	195.8
1666	DS	131	28	0.824	0.580	0.703	1.422	226.0
1667	DS	72	69	0.511	0.581	0.856	1.169	164.8
1668	DS	165	16	0.912	0.594	0.651	1.535	277.9
1671	DS	52	30	0.634	0.573	0.904	1.106	90.7
1672	DS	93	23	0.802	0.591	0.737	1.358	157.5
1673	DS	11	10	0.524	0.591	0.859	1.163	24.4
1674	DS	6	1	0.857	0.558	0.652	1.535	10.7
1681	DS	51	16	0.761	0.554	0.728	1.373	92.0
1682	DS	67	13	0.837	0.570	0.681	1.469	117.5
1683	DS	40	11	0.784	0.575	0.733	1.364	69.6
1731	EW	578	3	0.995	0.667	0.670	1.492	867.0

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
1733	EW	404	32	0.927	0.665	0.718	1.393	607.6
1734	EW	136	51	0.727	0.655	0.900	1.111	207.8
1735	EW	0	2	0.000	0.611	0.389	2.571	7.7
1741	EW	0	3	0.000	0.667	0.333	3.000	9.0
1743	EW	1	3	0.250	0.654	0.462	2.167	8.7
1751	EW	11	2	0.846	0.667	0.788	1.269	16.5
1753	EW	12	8	0.600	0.651	0.873	1.145	22.9
1761	EW	54	4	0.931	0.667	0.716	1.397	81.0
1763	EW	27	8	0.771	0.664	0.860	1.162	40.7
1764	EW	16	3	0.842	0.661	0.785	1.273	24.2
1773	EW	47	7	0.870	0.655	0.752	1.329	71.8
1774	EW	17	16	0.515	0.637	0.750	1.334	44.0
1775	EW	10	6	0.625	0.643	0.951	1.052	16.8
1781	EW	197	14	0.934	0.599	0.641	1.559	329.0
1812	IM	53	11	0.828	0.666	0.804	1.244	79.6
1820	IM	3	61	0.047	0.656	0.361	2.773	177.5
1821	IM	141	23	0.860	0.682	0.793	1.261	206.8
1903	OM	54	25	0.684	0.692	0.974	1.026	81.1
1918	OM	37	13	0.740	0.654	0.884	1.132	56.6
2186	NC	18	629	0.028	0.509	0.506	1.978	1279.9
2211	PC	9	38	0.191	0.603	0.491	2.039	95.8
2301	RM	9	12	0.429	0.555	0.779	1.284	27.0
2304	RM	1317	31	0.977	0.647	0.662	1.510	2035.9
2313	RM	580	335	0.634	0.565	0.891	1.122	1027.6
2314	RM	44	24	0.647	0.601	0.929	1.076	73.2
2318	RM	479	601	0.444	0.587	0.743	1.346	1453.8
2319	RM	208	240	0.464	0.585	0.775	1.290	577.8
2332	RM	1	0	1.000	0.636	0.636	1.571	1.6
2333	RM	7	7	0.500	0.578	0.843	1.186	16.6
2335	RM	0	5	0.000	0.593	0.407	2.455	12.3
2342	RM	651	75	0.897	0.624	0.696	1.438	1043.7
2345	RM	8	8	0.500	0.613	0.774	1.293	20.7
2346	RM	617	233	0.726	0.611	0.842	1.188	1009.9
2347	RM	1	1	0.500	0.636	0.727	1.375	2.7
2348	RM	4	0	1.000	0.568	0.568	1.762	7.0
2353	RM	14	2	0.875	0.606	0.692	1.445	23.1
2354	RM	0	29	0.000	0.623	0.377	2.655	77.0
2355	RM	8	41	0.163	0.596	0.483	2.073	101.6
2359	RM	153	141	0.520	0.594	0.848	1.180	346.9
2361	RM	7	24	0.226	0.554	0.576	1.736	53.8
2362	RM	1	0	1.000	0.568	0.568	1.762	1.8
2363	RM	40	32	0.556	0.581	0.942	1.062	76.4
2371	RM	95	444	0.176	0.609	0.475	2.104	1134.2
2372	RM	58	283	0.170	0.595	0.488	2.048	698.3
2374	RM	29	1	0.967	0.578	0.598	1.673	50.2
2393	RM	58	80	0.420	0.578	0.729	1.372	189.4
23CG	RM(SS)	0	9	0.000	0.606	0.394	2.537	22.8

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
23CQ	RM(SS)	201	1	0.995	0.628	0.631	1.585	320.3
23CR	RM(SS)	15	1	0.938	0.630	0.672	1.489	23.8
23CT	RM(SS)	48	0	1.000	0.580	0.580	1.725	82.8
23EA	RM(SS)	4	0	1.000	0.568	0.568	1.762	7.0
23EB	RM(SS)	0	2	0.000	0.550	0.450	2.220	4.4
23EJ	RM(SS)	222	12	0.949	0.584	0.616	1.625	380.1
23EK	RM(SS)	1	0	1.000	0.568	0.568	1.762	1.8
23EM	RM(SS)	12	0	1.000	0.579	0.579	1.729	20.7
23EN	RM(SS)	1	0	1.000	0.568	0.568	1.762	1.8
23EP	RM(SS)	4	2	0.667	0.577	0.866	1.155	6.9
23EQ	RM(SS)	1	1	0.500	0.584	0.832	1.202	2.4
23ER	RM(SS)	15	0	1.000	0.586	0.586	1.705	25.6
23MB	RM(SS)	1	0	1.000	0.532	0.532	1.881	1.9
23MF	RM(SS)	16	0	1.000	0.532	0.532	1.881	30.1
23MG	RM(SS)	32	0	1.000	0.565	0.565	1.769	56.6
23ML	RM(SS)	1	0	1.000	0.532	0.532	1.881	1.9
23MN	RM(SS)	10	0	1.000	0.532	0.532	1.881	18.8
23MQ	RM(SS)	163	1	0.994	0.594	0.598	1.673	274.3
23MS	RM(SS)	2	0	1.000	0.532	0.532	1.881	3.8
23MU	RM(SS)	165	0	1.000	0.652	0.652	1.533	253.0
23MV	RM(SS)	19	0	1.000	0.594	0.594	1.683	32.0
23MZ	RM(SS)	30	15	0.667	0.571	0.857	1.167	52.5
23NB	RM(SS)	83	5	0.943	0.647	0.686	1.457	128.2
23TA	RM(SS)	28	0	1.000	0.652	0.652	1.533	42.9
23TB	RM(SS)	30	5	0.857	0.609	0.710	1.408	49.3
23TC	RM(SS)	16	3	0.842	0.532	0.631	1.584	30.1
2511	YN	2	8	0.200	0.454	0.682	1.466	14.7
2512	YN	2	2	0.500	0.449	0.899	1.113	4.5
2514	YN	27	164	0.141	0.445	0.646	1.548	295.7
2516	YN	436	235	0.650	0.462	0.712	1.405	945.8
2526	YN	312	253	0.552	0.454	0.822	1.217	687.7
2612	PN	9	179	0.048	0.431	0.598	1.673	314.6
2703	DP	9	274	0.032	0.473	0.545	1.836	519.5
2704	DP	30	2	0.938	0.487	0.519	1.926	61.6
2705	DP	6	0	1.000	0.506	0.506	1.974	11.8
2706	DP	35	57	0.380	0.429	0.921	1.085	99.9
2707	DP	0	50	0.000	0.448	0.552	1.811	90.6
2708	DP	0	7	0.000	0.401	0.599	1.670	11.7
2734	DP	63	17	0.788	0.478	0.607	1.647	131.7
2741	DP	8	46	0.148	0.362	0.749	1.334	72.0
2742	DP	125	284	0.306	0.383	0.889	1.125	460.0
2743	DP	6	42	0.125	0.389	0.698	1.432	68.8
2744	DP	4	30	0.118	0.353	0.733	1.364	46.4
2745	DP	3	45	0.063	0.355	0.688	1.454	69.8
2746	DP	1	42	0.023	0.362	0.653	1.531	65.8
2747	DP	0	11	0.000	0.370	0.630	1.587	17.5
2750	DP	5	27	0.156	0.392	0.721	1.388	44.4

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
2751	DP	36	158	0.186	0.344	0.806	1.241	240.7
2752	DP	0	57	0.000	0.357	0.643	1.555	88.6
2753	DP	0	8	0.000	0.463	0.537	1.863	14.9
2759	DP	35	3	0.921	0.464	0.503	1.986	75.5
2813	SK	5	10	0.333	0.560	0.660	1.515	22.7
2814	SK	41	3	0.932	0.536	0.575	1.739	76.5
2815	SK	186	222	0.456	0.541	0.844	1.184	483.2
2816	SK	547	40	0.932	0.519	0.557	1.797	1054.8
2817	SK	573	67	0.895	0.555	0.620	1.612	1031.5
2818	SK	1	3	0.250	0.500	0.667	1.500	6.0
2819	SK	14	16	0.467	0.543	0.857	1.167	35.0
2821	SK	100	187	0.348	0.573	0.655	1.526	437.9
2823	SK	15	0	1.000	0.558	0.558	1.793	26.9
2824	SK	1	0	1.000	0.538	0.538	1.857	1.9
2825	SK	1	0	1.000	0.538	0.538	1.857	1.9
3111	SH	20	32	0.385	0.425	0.935	1.069	55.6
3112	SH	636	255	0.714	0.584	0.818	1.223	1089.8
3113	SH	93	285	0.246	0.565	0.577	1.733	655.0
3114	SH	20	111	0.153	0.426	0.678	1.476	193.3
3122	SH	721	13	0.982	0.673	0.685	1.460	1071.7
3154	SH	696	1	0.999	0.648	0.649	1.541	1074.3
3221	JO	358	128	0.737	0.544	0.738	1.355	658.7
3303	FTB,FT	260	15	0.945	0.556	0.588	1.701	467.7
3304	FTB,FT	26	8	0.765	0.559	0.731	1.367	46.5
3305	FTB,FT	244	39	0.862	0.555	0.643	1.554	439.9
3307	FTB,FT	0	1	0.000	0.558	0.442	2.263	2.3
3313	FTB,FT,MT	577	22	0.963	0.564	0.586	1.706	1022.2
3314	FTB,FT,MT	33	5	0.868	0.561	0.646	1.547	58.8
3315	FTB,FT,MT	309	8	0.975	0.564	0.579	1.728	547.7
3316	FTB,FT,MT	32	1	0.970	0.561	0.579	1.728	57.0
3317	FTB,FT,MT	188	26	0.879	0.563	0.641	1.560	333.8
3322	ET(b)	218	8	0.965	0.540	0.560	1.785	403.3
3323	ET(b)	53	11	0.828	0.533	0.643	1.555	99.5
3324	ET(b)	332	21	0.941	0.525	0.558	1.791	632.2
3325	ET(b)	11	2	0.846	0.519	0.614	1.630	21.2
3326	ET(b)	200	22	0.901	0.538	0.598	1.674	371.5
3327	ET(b)	52	9	0.852	0.532	0.624	1.602	97.7
3328	ET(b)	0	1	0.000	0.481	0.519	1.929	1.9
3332	ET	28	0	1.000	0.530	0.530	1.887	52.8
3334	ET	28	0	1.000	0.550	0.550	1.820	50.9
3336	ET	34	0	1.000	0.528	0.528	1.895	64.4
3349	FTB,FT,MT,ET	0	228	0.000	0.558	0.442	2.262	515.7
3351	MM(b)	120	0	1.000	0.667	0.667	1.500	180.0
3353	ET(b)	864	0	1.000	0.667	0.667	1.500	1296.0
3354	EM(b)	1206	14	0.989	0.667	0.674	1.483	1809.0
3355	MM(b)	1126	15	0.987	0.667	0.676	1.480	1689.0
3356	MM(b)	520	7	0.987	0.667	0.676	1.480	780.0

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k•	u(k•)	I(k•)/R	I(k•)
3359	ET,EM,MM,EN(b)	53	168	0.240	0.667	0.438	2.281	504.0
3361	MM(b)	174	0	1.000	0.667	0.667	1.500	261.0
3363	ET(b)	539	38	0.934	0.667	0.714	1.401	808.5
3364	EM(b)	989	48	0.954	0.667	0.699	1.431	1483.5
3365	MM,EN(b)	964	58	0.943	0.667	0.707	1.415	1446.0
3366	MM(b)	418	35	0.923	0.667	0.722	1.384	627.0
3383	ET(b)	193	0	1.000	0.667	0.667	1.500	289.5
3384	EM(b)	155	0	1.000	0.667	0.667	1.500	232.5
3385	MM(b)	354	0	1.000	0.667	0.667	1.500	531.0
3386	MM(b)	68	0	1.000	0.667	0.667	1.500	102.0
3389	ET,EM,MM,EN(b)	59	101	0.369	0.667	0.528	1.894	303.0
3393	ET(b)	84	4	0.955	0.667	0.698	1.432	126.0
3394	EM(b)	95	11	0.896	0.667	0.744	1.344	142.5
3395	MM,EN(b)	250	13	0.951	0.667	0.701	1.426	375.0
3396	MM,EM(b)	105	3	0.972	0.667	0.686	1.458	157.5
3524	MS	145	918	0.136	0.584	0.482	2.075	2254.0
3529	MS	1085	113	0.906	0.589	0.651	1.536	1840.6
3535	MS	15	100	0.130	0.591	0.470	2.126	244.5
3537	MS	16	26	0.381	0.583	0.673	1.486	62.4
3801	MU	0	10	0.000	0.500	0.500	2.000	20.0
3802	MU	1	8	0.111	0.500	0.563	1.778	16.0
3803	MU	8	62	0.114	0.500	0.565	1.771	124.0
3804	MU	1	6	0.143	0.500	0.583	1.714	12.0
3805	MU	17	63	0.213	0.500	0.635	1.575	126.0
3806	MU	22	107	0.171	0.500	0.603	1.659	214.0
3807	MU	2	17	0.105	0.500	0.559	1.789	34.0
3808	MU	3	18	0.143	0.500	0.583	1.714	36.0
3809	MU	14	75	0.157	0.500	0.593	1.685	150.0
3811	MU	3	13	0.188	0.500	0.615	1.625	26.0
3812	MU	4	30	0.118	0.500	0.567	1.765	60.0
3813	MU	10	55	0.154	0.500	0.591	1.692	110.0
3814	MU	6	36	0.143	0.500	0.583	1.714	72.0
3815	MU	6	34	0.150	0.500	0.588	1.700	68.0
3825	MU	3	41	0.068	0.500	0.537	1.864	82.0
3851	MU	7	38	0.156	0.500	0.592	1.689	76.0
3901	IS	75	186	0.287	0.491	0.714	1.401	365.6
3902	IS	163	31	0.840	0.493	0.586	1.706	330.9
3903	IS	114	110	0.509	0.498	0.978	1.022	229.0
3904	IS	31	1	0.969	0.498	0.514	1.946	62.3
3905	IS	53	2	0.964	0.483	0.501	1.995	109.7
4110	GSE,GSM	716	0	1.000	0.654	0.654	1.528	1094.2
4111	GSM,GS	129	34	0.791	0.629	0.795	1.258	205.1
4115	GSE,GS	79	21	0.790	0.531	0.672	1.488	148.8
4120	GSE,GSM	269	1	0.996	0.650	0.653	1.532	413.7
4121	GSM	114	44	0.722	0.640	0.887	1.127	178.1
4122	GSE	56	19	0.747	0.577	0.773	1.293	97.0
4127	GSE,GSM,GS	158	15	0.913	0.569	0.623	1.605	277.6

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
4131	GSE,GSM	12	0	1.000	0.569	0.569	1.757	21.1
4133	GSM,GS	25	0	1.000	0.621	0.621	1.611	40.3
4135	GSE,GS	16	0	1.000	0.547	0.547	1.828	29.3
4204	MM	387	41	0.904	0.669	0.740	1.352	578.7
4221	MM	65	33	0.663	0.642	0.968	1.033	101.2
4245	MM	1898	154	0.925	0.695	0.752	1.330	2729.3
4246	MM	7	3	0.700	0.698	0.997	1.003	10.0
4252	MM	2	3	0.400	0.621	0.632	1.583	7.9
4283	MM	318	90	0.779	0.699	0.897	1.115	455.0
4291	MM	367	45	0.891	0.698	0.783	1.277	526.2
4294	MM	771	193	0.800	0.693	0.867	1.153	1111.9
4295	MM	214	52	0.805	0.681	0.847	1.181	314.1
4296	MM	194	2	0.990	0.697	0.704	1.420	278.4
4301	EN	35	3	0.921	0.616	0.669	1.494	56.8
4314	EN	53	50	0.515	0.571	0.883	1.133	116.7
4315	EN	154	113	0.577	0.617	0.906	1.104	294.7
4316	EN	39	5	0.886	0.621	0.701	1.427	62.8
4317	EN	152	165	0.479	0.629	0.712	1.404	445.0
4318	EN	32	6	0.842	0.619	0.735	1.361	51.7
4331	EN	24	14	0.632	0.598	0.948	1.055	40.1
4355	EN	28	0	1.000	0.600	0.600	1.667	46.7
4362	EN	316	21	0.938	0.626	0.667	1.499	505.1
4365	EN	12	0	1.000	0.600	0.600	1.667	20.0
4366	EN	28	0	1.000	0.596	0.596	1.678	47.0
4381	EN	205	19	0.915	0.644	0.704	1.420	318.1
4382	EN	61	16	0.792	0.598	0.755	1.324	102.0
4398	EN	134	16	0.893	0.652	0.729	1.371	205.7
4501	BT	11	0	1.000	0.675	0.675	1.481	16.3
4502	BT	45	66	0.405	0.684	0.531	1.883	209.1
4503	BT	93	44	0.679	0.600	0.884	1.131	155.0
4505	BT	388	49	0.888	0.685	0.772	1.295	566.1
4507	BT	105	0	1.000	0.694	0.694	1.441	151.3
4511	BT	28	13	0.683	0.686	0.989	1.011	41.5
4512	BT	108	30	0.783	0.697	0.890	1.123	155.0
4513	BT	216	20	0.915	0.699	0.764	1.309	308.9
4515	BT	78	8	0.907	0.704	0.776	1.289	110.8
4531	BT	22	6	0.786	0.700	0.891	1.122	31.4
4532	BT	363	3	0.992	0.699	0.705	1.419	519.4
4533	BT	604	7	0.989	0.706	0.714	1.400	855.7
4615	EM	325	121	0.729	0.659	0.904	1.106	493.3
4616	EM	46	30	0.605	0.651	0.885	1.130	85.9
4621	EM	36	27	0.571	0.646	0.826	1.211	76.3
4626	EM	92	19	0.829	0.662	0.798	1.253	139.1
4631	EM	73	16	0.820	0.667	0.813	1.230	109.5
4632	EM	117	13	0.900	0.661	0.734	1.362	177.1
4666	EM	57	19	0.750	0.652	0.869	1.151	87.5
4668	EM	61	17	0.782	0.657	0.840	1.190	92.8

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k•	u(k•)	I(k•)/R	I(k•)
4669	EM	19	11	0.633	0.653	0.945	1.058	31.7
4671	EM	208	6	0.972	0.659	0.678	1.474	315.5
4672	EM	35	0	1.000	0.659	0.659	1.519	53.2
4673	EM	22	0	1.000	0.667	0.667	1.500	33.0
4701	IC	10	11	0.476	0.669	0.632	1.582	33.2
4703	IC	59	17	0.776	0.706	0.909	1.100	83.6
4704	IC	24	0	1.000	0.714	0.714	1.400	33.6
4705	IC	15	0	1.000	0.672	0.672	1.488	22.3
4706	IC	6	0	1.000	0.661	0.661	1.512	9.1
4711	IC	24	12	0.667	0.697	0.910	1.099	39.6
4712	IC	10	1	0.909	0.714	0.786	1.273	14.0
4713	IC	37	12	0.755	0.714	0.946	1.057	51.8
4714	IC	75	16	0.824	0.714	0.867	1.154	105.0
4715	IC	70	6	0.921	0.714	0.776	1.289	98.0
4721	IC	226	36	0.863	0.627	0.727	1.376	360.4
4722	IC	11	1	0.917	0.714	0.779	1.283	15.4
4723	IC	84	31	0.730	0.700	0.959	1.043	119.9
4724	IC	281	12	0.959	0.701	0.731	1.369	401.0
4725	IC	35	3	0.921	0.706	0.766	1.305	49.6
4727	IC	66	1	0.985	0.714	0.725	1.379	92.4
4728	IC	61	4	0.938	0.705	0.751	1.332	86.6
4731	IC	266	22	0.924	0.697	0.755	1.325	381.5
4734	IC	64	15	0.810	0.678	0.837	1.195	94.4
4745	IC	52	9	0.852	0.714	0.838	1.193	72.8
4746	IC	390	65	0.857	0.713	0.831	1.203	547.3
4747	IC	68	50	0.576	0.694	0.722	1.385	163.5
4749	IC	17	54	0.239	0.714	0.376	2.662	189.0
4752	IC	73	2	0.973	0.706	0.725	1.379	103.4
4762	IC	55	0	1.000	0.714	0.714	1.400	77.0
4771	IC	20	10	0.667	0.714	0.857	1.167	35.0
4772	IC	36	9	0.800	0.714	0.893	1.120	50.4
4773	IC	37	15	0.712	0.714	0.990	1.010	52.5
4774	IC	150	19	0.888	0.711	0.801	1.249	211.1
4775	IC	238	3	0.988	0.714	0.723	1.383	333.2
4776	IC	51	3	0.944	0.711	0.753	1.328	71.7
4911	HT	1	0	1.000	0.613	0.613	1.632	1.6
4921	HT	52	36	0.591	0.659	0.834	1.200	105.6
4931	HT	70	44	0.614	0.680	0.830	1.205	137.3
4932	HT	51	28	0.646	0.700	0.847	1.180	93.3
4933	HT	23	26	0.469	0.682	0.598	1.671	81.9
4934	HT	41	37	0.526	0.699	0.635	1.576	122.9
4935	HT	29	18	0.617	0.682	0.829	1.206	56.7
4936	HT	15	16	0.484	0.644	0.690	1.450	45.0
4937	HT	15	11	0.577	0.638	0.856	1.168	30.4
4938	HT	6	5	0.545	0.623	0.830	1.205	13.3
4939	HT	13	6	0.684	0.633	0.925	1.081	20.5
4941	HT	30	39	0.435	0.672	0.580	1.724	119.0

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
4954	HT	1313	96	0.932	0.704	0.755	1.324	1865.3
4955	HT	415	315	0.568	0.689	0.720	1.388	1013.2
4956	HT	144	59	0.709	0.687	0.968	1.033	209.7
5311	b,c	131	84	0.609	0.667	0.853	1.172	252.0
5320	b,c	0	1	0.000	0.680	0.320	3.125	3.1
5321	b,c	87	10	0.897	0.714	0.796	1.256	121.8
5322	b,c	8	1	0.889	0.714	0.804	1.244	11.2
5323	b,c	0	14	0.000	0.714	0.286	3.500	52.5
5325	b,c	0	3	0.000	0.714	0.286	3.500	10.5
5326	b,c	674	130	0.838	0.714	0.852	1.174	943.6
5327	b,c	49	3	0.942	0.714	0.758	1.319	68.6
5331	b,c	49	21	0.700	0.500	0.714	1.400	98.0
5332	b,c	187	201	0.482	0.500	0.965	1.036	402.0
5333	b,c	47	44	0.516	0.500	0.968	1.033	94.0
5341	b,c	57	49	0.538	0.500	0.930	1.075	114.0
5342	b,c	377	262	0.590	0.667	0.813	1.230	786.0
5343	b,c	308	101	0.753	0.667	0.885	1.130	462.0
5345	c	550	61	0.900	0.673	0.748	1.337	814.2
5346	b,c	13	5	0.722	0.500	0.692	1.444	26.0
5501	EA	80	50	0.615	0.492	0.799	1.251	162.7
5503	EA	20	12	0.625	0.518	0.828	1.208	38.6
5601	CE	33	18	0.647	0.564	0.872	1.147	58.5
5633	CE	27	23	0.540	0.534	0.989	1.011	50.6
5635	CE	46	16	0.742	0.557	0.751	1.332	82.6
5642	CE	14	13	0.519	0.579	0.874	1.144	30.9
5644	CE	45	8	0.849	0.571	0.673	1.486	78.8
5707	EO	44	0	1.000	0.520	0.520	1.923	84.6
5708	EO	38	2	0.950	0.555	0.584	1.712	68.5
5710	EO	77	15	0.837	0.536	0.640	1.562	143.7
5804	CM	14	11	0.560	0.574	0.967	1.034	25.8
5805	CM	71	28	0.717	0.558	0.778	1.285	127.2
5907	BU	109	17	0.865	0.552	0.638	1.567	197.4
5908	BU	12	21	0.364	0.581	0.659	1.517	50.1
5915	BU	78	31	0.716	0.525	0.734	1.362	148.5
5931	BU(b)	24	24	0.500	0.622	0.757	1.321	63.4
5932	BU(b)	56	4	0.933	0.667	0.714	1.400	84.0
6010	SW	43	11	0.796	0.544	0.683	1.465	79.1
6021	SW	26	27	0.491	0.509	0.964	1.037	55.0
6102	UT	45	13	0.776	0.571	0.736	1.359	78.8
6104	UT	80	55	0.593	0.566	0.956	1.047	141.3
6105	UT	24	11	0.686	0.575	0.839	1.192	41.7
6313	AZ	230	341	0.403	0.487	0.859	1.164	664.9
6401	AD	40	5	0.889	0.523	0.588	1.701	76.5
6402	AD	32	72	0.308	0.511	0.706	1.416	147.2
6409	AD	9	20	0.310	0.523	0.692	1.445	41.9
6412	AD	0	45	0.000	0.521	0.479	2.088	94.0
6414	AD	40	53	0.430	0.528	0.828	1.208	112.3

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
6415	AD	85	278	0.234	0.517	0.630	1.586	575.9
6416	AD	66	316	0.173	0.519	0.581	1.721	657.6
6417	AD	17	10	0.630	0.511	0.811	1.233	33.3
6418	AD	112	174	0.392	0.518	0.792	1.263	361.1
6419	AD	73	250	0.226	0.520	0.620	1.613	520.9
6420	AD	19	85	0.183	0.520	0.588	1.702	177.0
6421	AD	64	71	0.474	0.519	0.915	1.092	147.5
6422	AD	50	130	0.278	0.508	0.681	1.469	264.4
6423	AD	20	15	0.571	0.528	0.925	1.082	37.9
6424	AD	22	15	0.595	0.518	0.871	1.148	42.5
6426	AD	2	15	0.118	0.516	0.548	1.825	31.0
6429	AD	2	0	1.000	0.511	0.511	1.958	3.9
6522	AX	0	15	0.000	0.537	0.463	2.160	32.4
6526	AX	55	27	0.671	0.548	0.817	1.224	100.3
6527	AX	7	11	0.389	0.506	0.808	1.238	22.3
6529	AX	61	51	0.545	0.544	1.000	1.000	112.0
6533	AX	0	12	0.000	0.538	0.462	2.165	26.0
6534	AX	32	50	0.390	0.531	0.770	1.299	106.5
6555	AX	69	26	0.726	0.521	0.718	1.393	132.4
6569	AX	35	38	0.479	0.525	0.913	1.095	80.0
6571	AX	36	2	0.947	0.529	0.558	1.792	68.1
6582	AX	71	154	0.316	0.524	0.696	1.437	323.3
6583	AX	43	22	0.662	0.524	0.792	1.263	82.1
6585	AX	66	23	0.742	0.543	0.732	1.366	121.6
6586	AX	202	48	0.808	0.509	0.630	1.588	397.0
6602	AT	2	10	0.167	0.536	0.557	1.796	21.6
6603	AT	24	4	0.857	0.530	0.618	1.617	45.3
6605	AT	143	113	0.559	0.545	0.976	1.025	262.4
6606	AT	22	37	0.373	0.536	0.740	1.352	79.7
6607	AT	47	21	0.691	0.538	0.778	1.285	87.4
6608	AT	14	24	0.368	0.540	0.729	1.372	52.2
6609	AT	103	59	0.636	0.538	0.847	1.181	191.3
6611	AT	199	199	0.500	0.539	0.921	1.086	432.1
6612	AT	155	136	0.533	0.537	0.991	1.009	293.7
6613	AT	4	13	0.235	0.537	0.606	1.651	28.1
6614	AT	22	12	0.647	0.534	0.826	1.211	41.2
6615	AT	24	12	0.667	0.550	0.824	1.213	43.7
6616	AT	0	4	0.000	0.533	0.467	2.142	8.6
6618	AT	4	3	0.571	0.500	0.875	1.143	8.0
6619	AT	24	3	0.889	0.546	0.614	1.628	44.0
6620	AT	6	2	0.750	0.542	0.722	1.385	11.1
6621	AT	36	11	0.766	0.537	0.701	1.427	67.1
6623	AT	0	2	0.000	0.500	0.500	2.000	4.0
6624	AT	0	1	0.000	0.556	0.444	2.250	2.3
6625	AT	14	70	0.167	0.531	0.563	1.777	149.3
6626	AT	0	4	0.000	0.514	0.486	2.057	8.2
6628	AT	16	20	0.444	0.539	0.829	1.206	43.4

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
6629	AT	33	31	0.516	0.540	0.949	1.053	67.4
6631	AT	14	4	0.778	0.536	0.690	1.450	26.1
6634	AT	56	34	0.622	0.537	0.863	1.158	104.2
6635	AT	24	23	0.511	0.528	0.964	1.037	48.7
6638	AT	12	3	0.800	0.552	0.690	1.450	21.7
6639	AT	61	23	0.726	0.536	0.739	1.354	113.7
6640	AT	17	4	0.810	0.532	0.658	1.521	31.9
6641	AT	66	21	0.759	0.545	0.719	1.391	121.0
6643	AT	0	18	0.000	0.538	0.462	2.166	39.0
6644	AT	0	8	0.000	0.540	0.460	2.172	17.4
6645	AT	13	13	0.500	0.511	0.979	1.022	26.6
6646	AT	14	4	0.778	0.538	0.692	1.445	26.0
6647	AT	33	10	0.767	0.552	0.719	1.390	59.8
6648	AT	22	12	0.647	0.535	0.827	1.210	41.1
6649	AT	15	4	0.789	0.526	0.666	1.502	28.5
6650	AT	5	9	0.357	0.505	0.770	1.298	18.2
6651	AT	18	7	0.720	0.536	0.744	1.344	33.6
6652	AT	107	64	0.626	0.540	0.863	1.159	198.2
6653	AT	85	63	0.574	0.536	0.933	1.072	158.6
6654	AT	13	0	1.000	0.541	0.541	1.848	24.0
6655	AT	1	2	0.333	0.519	0.722	1.385	4.2
6656	AT	11	22	0.333	0.540	0.689	1.451	47.9
6658	AT	10	17	0.370	0.536	0.736	1.358	36.7
6659	AT	54	20	0.730	0.554	0.759	1.318	97.5
6660	AT	13	4	0.765	0.546	0.714	1.401	23.8
6662	AT	4	29	0.121	0.540	0.524	1.909	63.0
6663	AT	31	27	0.534	0.533	0.997	1.003	58.2
6664	AT	29	20	0.592	0.543	0.917	1.090	53.4
6665	AT	17	13	0.567	0.524	0.924	1.082	33.6
6667	AT	0	1	0.000	0.556	0.444	2.250	2.3
6668	AT	156	38	0.804	0.535	0.666	1.503	291.5
6669	AT	7	14	0.333	0.539	0.691	1.448	30.4
6670	AT	11	3	0.786	0.536	0.683	1.465	20.5
6671	AT	18	43	0.295	0.536	0.658	1.520	92.7
6672	AT	47	33	0.587	0.540	0.918	1.089	87.1
6673	AT	147	264	0.358	0.534	0.726	1.378	566.4
6674	AT	22	11	0.667	0.540	0.811	1.234	40.7
6675	AT	1	0	1.000	0.544	0.544	1.838	5.5
6676	AT	24	1	0.960	0.556	0.579	1.728	43.2
6677	AT	11	4	0.733	0.552	0.753	1.329	19.9
6679	AT	11	1	0.917	0.538	0.587	1.702	20.4
6680	AT	12	2	0.857	0.556	0.648	1.543	21.6
6681	AT	28	0	1.000	0.536	0.536	1.866	52.2
6682	AT	25	1	0.962	0.542	0.564	1.774	46.1
6683	AT	83	22	0.790	0.554	0.701	1.427	149.8
6684	AT	30	13	0.698	0.509	0.730	1.370	58.9
6686	AT	29	15	0.659	0.531	0.806	1.240	54.6

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
6687	AT	7	14	0.333	0.548	0.678	1.475	31.0
6688	AT	5	10	0.333	0.530	0.705	1.418	21.3
6691	AT	41	13	0.759	0.539	0.710	1.409	76.1
6692	AT	70	59	0.543	0.515	0.950	1.053	135.8
6696	AT	13	0	1.000	0.532	0.532	1.879	24.4
6697	AT	13	0	1.000	0.528	0.528	1.895	24.6
6801	AO	62	40	0.608	0.620	0.969	1.032	105.2
6802	AO	181	148	0.550	0.624	0.837	1.195	393.1
6803	AO	25	21	0.543	0.639	0.792	1.263	58.1
6804	AO	133	34	0.796	0.626	0.786	1.273	212.6
6806	AO	18	10	0.643	0.628	0.976	1.024	28.7
6901	AC	27	151	0.152	0.391	0.718	1.393	247.9
6902	AC	293	67	0.814	0.408	0.501	1.994	717.9
7022	AB,ABF	328	86	0.792	0.619	0.781	1.280	529.9
7105	AE	70	74	0.486	0.536	0.903	1.108	159.5
7106	AE	21	8	0.724	0.538	0.744	1.345	39.0
7107	AE	0	3	0.000	0.538	0.462	2.167	6.5
7109	AE	0	4	0.000	0.538	0.462	2.167	8.7
7112	AE	0	4	0.000	0.519	0.481	2.078	8.3
7114	AE	0	32	0.000	0.534	0.466	2.144	68.6
7116	AE	34	17	0.667	0.538	0.807	1.239	63.2
7117	AE	29	14	0.674	0.534	0.792	1.263	54.3
7128	AE	0	1	0.000	0.519	0.481	2.077	2.1
7129	AE	25	8	0.758	0.537	0.708	1.412	46.6
7133	AE	17	17	0.500	0.533	0.935	1.070	36.4
7135	AE	3	3	0.500	0.535	0.930	1.076	6.5
7136	AE	104	88	0.542	0.535	0.988	1.012	194.3
7144	AE	27	65	0.293	0.531	0.664	1.507	138.6
7147	AE	116	68	0.630	0.538	0.853	1.173	215.8
7166	AE	26	56	0.317	0.537	0.678	1.474	120.9
7171	AE	4	0	1.000	0.528	0.528	1.892	7.6
7172	AE	7	3	0.700	0.523	0.747	1.339	13.4
7173	AE	26	21	0.553	0.528	0.955	1.047	49.2
7174	AE	63	29	0.685	0.535	0.781	1.280	117.8
7181	AE	253	84	0.751	0.529	0.705	1.419	478.3
7182	AE	62	116	0.348	0.531	0.720	1.389	247.3
7184	AE	16	22	0.421	0.537	0.800	1.250	47.5
7197	AE	27	17	0.614	0.524	0.855	1.170	51.5
7212	AME,AMH,AMS	234	246	0.488	0.507	0.962	1.040	499.1
7222	AME,AMH,AMS	39	60	0.394	0.511	0.806	1.240	122.8
7223	AME,AMH,AMS	31	44	0.413	0.523	0.813	1.230	92.3
7225	AME,AMH,AMS,AM	98	121	0.447	0.513	0.881	1.135	248.5
7352	PR	6	9	0.400	0.488	0.853	1.172	17.6
7354	PR	6	5	0.545	0.393	0.721	1.387	15.3
7412	AG	164	224	0.423	0.472	0.915	1.093	424.1
7414	AG	123	4	0.969	0.500	0.516	1.937	246.0
7514	TD	1	8	0.111	0.429	0.643	1.556	14.0

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
7523	TD	0	106	0 000	0.429	0.571	1.750	185.5
7815	AW	1	21	0.045	0 563	0.458	2.183	48.0
7821	AW	621	214	0.744	0 558	0.750	1.333	1113.1
7825	AW	122	168	0.421	0.543	0.788	1.269	367.9
7826	AW	139	2	0.986	0.559	0.567	1.762	248.5
7831	AW	170	30	0.850	0.560	0.659	1.517	303 3
7851	AW	28	64	0.304	0.555	0.639	1.564	143.9
7861	AW	288	38	0.883	0.564	0.638	1.567	510.8
7871	AW	117	72	0.619	0.563	0.909	1.100	207.9
7872	AW	284	40	0.877	0.568	0.648	1.543	499.8
7873	AW	88	38	0.698	0.556	0.796	1.257	158.3
7881	AW	0	26	0.000	0.557	0.443	2.259	58.7
7918	AQ	0	5	0.000	0.513	0.487	2.055	10.3
7919	AQ	5	6	0.455	0.480	0.953	1.049	11.5
7921	AQ	18	8	0.692	0.571	0.825	1.212	31.5
7922	AQ	4	6	0.400	0.498	0.836	1.196	12.0
7923	AQ	9	3	0.750	0.556	0.742	1.348	16.2
7931	AQ	0	5	0.000	0.571	0.429	2.333	11.7
7934	AQ	0	10	0.000	0.558	0.442	2.260	22.6
7935	AQ	0	3	0.000	0.541	0.459	2.178	6.5
7936	AQ	0	3	0.000	0.541	0.459	2.178	6.5
7937	AQ	0	2	0.000	0.571	0.429	2.333	4.7
7953	AQ	57	30	0.655	0.552	0.842	1.188	103.3
7954	AQ	19	9	0.679	0.549	0.808	1.237	34.6
7955	AQ	38	9	0.809	0.546	0.675	1.480	69.6
7958	AQ	157	66	0.704	0.548	0.778	1.285	286.5
7959	AQ	51	11	0.823	0 568	0.691	1.447	89.7
7963	AQ	0	1	0.000	0.480	0.520	1.923	1.9
7964	AQ	33	11	0.750	0.557	0 743	1 346	59.2
7967	AQ	72	25	0.742	0.518	0.697	1.434	139.1
7969	AQ	50	37	0.575	0.552	0.961	1.040	90.5
7971	AQ	3	1	0.750	0.480	0.640	1.563	6.3
7972	AQ	14	7	0.667	0.563	0.844	1.185	24.9
7974	AQ	3	4	0.429	0.558	0.773	1.294	9.1
7975	AQ	34	6	0.850	0.569	0.670	1.493	59.7
7976	AQ	2	5	0.286	0.558	0.618	1.617	11.3
7983	AQ	0	7	0.000	0.556	0.444	2.253	15.8
7984	AQ	48	18	0.727	0.561	0.771	1.297	86.9
7985	AQ	9	7	0.563	0.498	0.886	1.129	18.1
7988	AQ	0	11	0.000	0.538	0.462	2.165	23.8
7989	AQ	24	9	0.727	0.558	0.767	1.304	43.0
7991	AQ	26	4	0.867	0.568	0.656	1.525	45.8
7992	AQ	0	7	0.000	0.571	0.429	2.333	16.3
8011	AK	116	214	0.352	0.554	0.688	1.454	480.0
8126	PH	55	64	0.462	0.465	0.994	1.006	119.7
8133	PH	103	104	0.498	0.523	0.950	1.053	218.0
8136	PH	2	1	0.667	0.538	0.808	1.238	3.7

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
8143	PH	19	32	0.373	0.510	0.781	1.280	65.3
8144	PH	20	28	0.417	0.440	0.959	1.042	50.0
8146	PH	3	7	0.300	0.440	0.800	1.250	12.5
8148	PH	18	62	0.225	0.460	0.697	1.434	114.7
8149	PH	0	2	0.000	0.414	0.586	1.706	3.4
8192	PH	89	55	0.618	0.507	0.820	1.220	175.7
8202	c	4	33	0.108	0.525	0.533	1.878	69.5
8211	c	17	93	0.155	0.523	0.565	1.771	194.8
8215	c	128	240	0.348	0.523	0.731	1.368	503.4
8216	c	214	42	0.836	0.519	0.620	1.612	412.6
8225	c	32	25	0.561	0.520	0.926	1.080	61.5
8226	c	161	64	0.716	0.529	0.739	1.353	304.4
8241	c	56	158	0.262	0.525	0.643	1.556	332.9
8243	c	32	45	0.416	0.518	0.824	1.213	93.4
8244	c	0	16	0.000	0.523	0.477	2.096	33.5
8245	c	6	26	0.188	0.516	0.595	1.680	53.8
8250	c	0	56	0.000	0.513	0.487	2.055	115.1
8251	c	691	329	0.677	0.515	0.761	1.315	1341.0
8252	c	105	10	0.913	0.513	0.562	1.779	204.6
8258	c	69	59	0.539	0.514	0.953	1.049	134.3
8261	AT,AX,AV	52	87	0.374	0.532	0.748	1.336	185.7
8263	AT,AX,AV	308	100	0.755	0.526	0.697	1.435	585.5
8264	AT,AV	42	27	0.609	0.530	0.870	1.149	79.3
8265	AT,AX,AV,RM	85	105	0.447	0.527	0.855	1.169	222.2
8267	AT,AV	0	5	0.000	0.522	0.478	2.093	10.5
8269	AT,AV	16	13	0.552	0.517	0.938	1.066	30.9
8271	AO	317	103	0.755	0.625	0.828	1.208	507.3
8273	RM	72	9	0.889	0.608	0.684	1.462	118.4
8274	c	72	5	0.935	0.520	0.556	1.799	138.5
8275	AT	108	12	0.900	0.524	0.583	1.716	205.9
8276	c	2	5	0.286	0.523	0.667	1.499	10.5
8278	c	52	73	0.416	0.534	0.798	1.253	156.6
8284	AT,AE,AV	257	45	0.851	0.531	0.624	1.603	484.1
8288	PH	47	31	0.603	0.505	0.838	1.193	93.1
8289	c	25	141	0.151	0.528	0.555	1.801	299.0
8294	HM	37	111	0.250	0.468	0.709	1.410	208.7
8295	CTI,CTO,CTR,CTT	101	154	0.396	NA	NA	NA	NA
8300	AO,AZ,PR,AF,AV	30	44	0.405	0.500	0.841	1.189	88.0
8301	c	24	4	0.857	0.508	0.593	1.688	47.3
8302	c	0	177	0.000	0.520	0.480	2.085	369.1
8303	c	109	147	0.426	0.518	0.840	1.190	304.7
8304	c	203	108	0.653	0.521	0.797	1.254	390.0
8305	c	558	384	0.592	0.514	0.868	1.153	1085.8
8306	AE,AT,AF,AV	190	94	0.669	0.533	0.797	1.255	356.3
8307	AT,AE,AV	25	57	0.305	0.527	0.680	1.470	120.5
8308	c	26	151	0.147	0.522	0.560	1.785	316.0
8310	c	0	318	0.000	0.515	0.485	2.062	655.7

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
8317	c	290	7	0.976	0.520	0.533	1.876	557.3
8318	c	72	125	0.365	0.517	0.762	1.312	258.6
8319	c	1241	819	0.602	0.515	0.854	1.170	2411.2
8323	c	0	302	0.000	0.536	0.464	2.157	651.3
8326	c	11	156	0.066	0.534	0.499	2.005	334.9
8327	c	2535	1051	0.707	0.541	0.765	1.307	4686.8
8331	c	1822	601	0.752	0.538	0.716	1.397	3385.0
8332	c	701	177	0.798	0.523	0.656	1.525	1339.3
8333	c	5	75	0.063	0.523	0.508	1.967	157.4
8342	c	727	823	0.469	0.541	0.865	1.156	1791.7
8344	c	0	35	0.000	0.516	0.484	2.068	72.4
8345	c	3001	1300	0.698	0.536	0.768	1.301	5597.4
8346	c	1456	448	0.765	0.531	0.694	1.441	2744.0
8351	c	139	1562	0.082	0.528	0.514	1.947	3312.4
8357	c	279	150	0.650	0.523	0.804	1.244	533.9
8374	c	2	51	0.038	0.537	0.481	2.078	110.1
8375	c	709	493	0.590	0.523	0.887	1.128	1355.3
8376	c	355	319	0.527	0.524	0.995	1.005	677.6
8377	c	1045	828	0.558	0.523	0.938	1.066	1996.4
8379	c	328	179	0.647	0 520	0.804	1.243	630.2
8380	c	27	136	0.166	0.520	0.575	1.738	283.4
8381	c	44	139	0.240	0.521	0.631	1.584	289.9
8402	HM(b)	202	130	0.608	0.500	0.822	1.217	404.0
8404	HM	2465	317	0.886	0.473	0.534	1.874	5212.8
8406	HM(b)	262	258	0.504	0.500	0.992	1.008	524.0
8407	HM(b)	37	31	0.544	0.500	0.919	1.088	74.0
8408	HM(b)	5	96	0.050	0.429	0.601	1.663	168.0
8409	HM(b)	0	116	0.000	0.429	0.571	1.750	203.0
8416	HM(b)	4	69	0.055	0.429	0.605	1.654	120.8
8425	HM(b)	653	578	0.530	0.500	0.943	1.061	1309.2
8432	HM(b)	247	332	0.427	0.500	0.872	1.147	664.0
8433	HM(b)	0	53	0.000	0.429	0.571	1.750	92.8
8444	HM(b)	5	139	0.035	0.429	0.592	1.689	243.3
8445	HM(b)	4	71	0.053	0.429	0.604	1.657	124.3
8446	HM(b)	4	112	0.034	0.429	0.592	1.690	196.0
8451	HM(b)	87	176	0.331	0.429	0.854	1.171	310.3
8452	HM(b)	122	499	0.196	0.429	0.711	1.406	876.1
8454	HM(b)	4	32	0.111	0.429	0.643	1.556	56.0
8463	HM(b)	3	185	0.016	0.429	0.581	1.722	323.8
8466	HM(b)	11	180	0.058	0.429	0.606	1.649	315.0
8472	HM(b)	2	39	0.049	0.429	0.601	1.665	68.3
8477	HM(b)	6	108	0.053	0.429	0.603	1.658	189.0
8478	HM(b)	58	201	0.224	0.429	0.736	1.358	351.8
8482	HM(b)	165	708	0.189	0.429	0.705	1.419	1239.0
8483	HM(b)	284	634	0.309	0.429	0.827	1.209	1109.5
8485	HM(b)	14	352	0.038	0.429	0.594	1.683	616.0
8486	HM(b)	4	76	0.050	0.429	0.602	1.663	133.0

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
8489	HM(b)	9	109	0.076	0.429	0.619	1.617	190.8
8492	HM(b)	21	13	0.618	0.667	0.872	1.147	39.0
8493	HM(b)	50	29	0.633	0.667	0.908	1.101	87.0
8495	HM(b)	5	45	0.100	0.429	0.635	1.575	78.8
8496	HM(b)	4	18	0.182	0.500	0.611	1.636	36.0
8501	HM(b)	146	418	0.259	0.429	0.771	1.297	735.4
8503	HM(b)	1	41	0.024	0.429	0.585	1.708	71.8
8505	HM(b)	3	34	0.081	0.429	0.622	1.608	59.5
8506	HM(b)	140	981	0.125	0.429	0.653	1.531	1716.8
8541	HM(b)	3	104	0.028	0.429	0.588	1.701	182.0
8703	DT	107	147	0.421	0.429	0.987	1.013	257.2
8705	DT	0	13	0.000	0.429	0.571	1.750	22.8
8707	DT	197	6	0.970	0.428	0.441	2.268	460.3
8714	DT	1	21	0.045	0.429	0.599	1.670	36.8
8732	DT(b)	15	71	0.174	0.429	0.692	1.445	124.3
8752	DT(b)	67	219	0.234	0.429	0.746	1.340	383.3
8753	DT(b)	58	119	0.328	0.429	0.850	1.177	208.2
8765	DT	0	6	0.000	0.429	0.571	1.750	10.5
9107	CTM,CTR	0	14	0.000	NA	NA	NA	NA
9108	CTM,CTO	1	23	0.042	NA	NA	NA	NA
9109	CTM,CTO,CTR,CTT	4	99	0.039	NA	NA	NA	NA
9110	CTR	2	3	0.400	NA	NA	NA	NA
9116	CTI,CTR	20	25	0.444	NA	NA	NA	NA
9117	CT	0	4	0.000	NA	NA	NA	NA
9118	CTI,CTR,CTT	72	224	0.243	NA	NA	NA	NA
9121	CTI,CTR,CTT	29	8	0.784	NA	NA	NA	NA
9123	CTI,CTR,CTT	6	14	0.300	NA	NA	NA	NA
9124	CTI,CTR,CTT	97	198	0.329	NA	NA	NA	NA
9125	CTR,CTT	128	5	0.962	NA	NA	NA	NA
9127	CTR,CTT	0	11	0.000	NA	NA	NA	NA
9128	CTR,CTT	8	36	0.182	NA	NA	NA	NA
9129	CTR,CTT	3	126	0.023	NA	NA	NA	NA
9130	CTR	4	0	1.000	NA	NA	NA	NA
9132	CTO,CTR,CTT	16	0	1.000	NA	NA	NA	NA
9140	CTT	21	88	0.193	NA	NA	NA	NA
9141	CTT	25	168	0.130	NA	NA	NA	NA
9142	CTT	96	129	0.427	NA	NA	NA	NA
9143	CTT	23	60	0.277	NA	NA	NA	NA
9144	CTT	0	8	0.000	NA	NA	NA	NA
9145	CTT	128	144	0.471	NA	NA	NA	NA
9146	CTT	17	48	0.262	NA	NA	NA	NA
9147	CTT	33	101	0.246	NA	NA	NA	NA
9148	CTT	15	71	0.174	NA	NA	NA	NA
9149	CTT	0	32	0.000	NA	NA	NA	NA
9150	CTT	0	4	0.000	NA	NA	NA	NA
9151	CTT	14	115	0.109	NA	NA	NA	NA
9152	CTT	0	50	0.000	NA	NA	NA	NA

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
9154	CTT	89	38	0.701	NA	NA	NA	NA
9155	CTT	21	29	0.420	NA	NA	NA	NA
9156	CTT	7	4	0.636	NA	NA	NA	NA
9157	CTT	15	3	0.833	NA	NA	NA	NA
9165	CTR	176	245	0.418	NA	NA	NA	NA
9167	CTR	5	5	0.500	NA	NA	NA	NA
9169	CTR	35	52	0.402	NA	NA	NA	NA
9181	CTO	39	128	0.234	NA	NA	NA	NA
9182	CTO	15	96	0.135	NA	NA	NA	NA
9183	CTO	35	121	0.224	NA	NA	NA	NA
9184	CTO	32	59	0.352	NA	NA	NA	NA
9185	CTO	220	55	0.800	NA	NA	NA	NA
9190	CTA	50	76	0.397	NA	NA	NA	NA
9201	CTI	157	105	0.599	NA	NA	NA	NA
9203	CTI	37	75	0.330	NA	NA	NA	NA
9204	CTI	2	24	0.077	NA	NA	NA	NA
9209	CTI	0	16	0.000	NA	NA	NA	NA
9211	CTI	4	28	0.125	NA	NA	NA	NA
9212	CTI	26	7	0.788	NA	NA	NA	NA
9213	CTI	0	3	0.000	NA	NA	NA	NA
9215	CTI	0	11	0.000	NA	NA	NA	NA
9216	CTI	21	20	0.512	NA	NA	NA	NA
9230	CTI	41	73	0.360	NA	NA	NA	NA
9231	CTI	1	11	0.083	NA	NA	NA	NA
9232	CTI	6	0	1.000	NA	NA	NA	NA
9233	CTI	1	25	0.038	NA	NA	NA	NA
9235	CTI	0	4	0.000	NA	NA	NA	NA
9236	CTI	13	4	0.765	NA	NA	NA	NA
9240	CTI	1	21	0.045	NA	NA	NA	NA
9241	CTI	0	2	0.000	NA	NA	NA	NA
9243	CTI	0	6	0.000	NA	NA	NA	NA
9246	CTI	1	0	1.000	NA	NA	NA	NA
9250	CTM	30	48	0.385	NA	NA	NA	NA
9251	CTM	19	34	0.358	NA	NA	NA	NA
9252	CTM	41	60	0.406	NA	NA	NA	NA
9253	CTM	0	1	0.000	NA	NA	NA	NA
9254	CTM	0	23	0.000	NA	NA	NA	NA
9255	CTM	2	6	0.250	NA	NA	NA	NA
9256	CTM	16	22	0.421	NA	NA	NA	NA
9260	CTM	8	21	0.276	NA	NA	NA	NA
9261	CTM	13	47	0.217	NA	NA	NA	NA
9262	CTM	3	20	0.130	NA	NA	NA	NA
9264	CTM	3	2	0.600	NA	NA	NA	NA
9265	CTM	1	5	0.167	NA	NA	NA	NA
9266	CTM	3	15	0.167	NA	NA	NA	NA
9267	CTM	3	22	0.120	NA	NA	NA	NA
9268	CTM	18	59	0.234	NA	NA	NA	NA

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
9269	CTM	15	12	0.556	NA	NA	NA	NA
9270	CTM	7	32	0.179	NA	NA	NA	NA
9271	CTM	15	44	0.254	NA	NA	NA	NA
9272	CTM	6	0	1.000	NA	NA	NA	NA
9273	CTM	7	9	0.438	NA	NA	NA	NA
9274	CTM	2	4	0.333	NA	NA	NA	NA
9275	CTM	0	10	0.000	NA	NA	NA	NA
9276	CTM	0	11	0.000	NA	NA	NA	NA
9277	CTM	0	6	0.000	NA	NA	NA	NA
9278	CTM	2	9	0.182	NA	NA	NA	NA
9280	CTM	24	31	0.436	NA	NA	NA	NA
9281	CTM	50	26	0.658	NA	NA	NA	NA
9282	CTM	4	35	0.103	NA	NA	NA	NA
9283	CTM	1	23	0.042	NA	NA	NA	NA
9284	CTM	0	75	0.000	NA	NA	NA	NA
9287	CTM	2	0	1.000	NA	NA	NA	NA
9290	CTM	2	18	0.100	NA	NA	NA	NA
9291	CTM	7	2	0.778	NA	NA	NA	NA
9292	CTM	2	4	0.333	NA	NA	NA	NA
9293	CTM	22	34	0.393	NA	NA	NA	NA
9294	CTM	15	21	0.417	NA	NA	NA	NA
9296	CTM	0	6	0.000	NA	NA	NA	NA
9501	c	0	164	0.000	0.541	0.459	2.177	322.2
9502	c	568	14922	0.037	0.560	0.456	2.191	32238.9
9503	c	0	6	0.000	0.491	0.509	1.966	11.8
9504	c	0	1	0.000	0.579	0.421	2.374	4.7
9505	c	0	148	0.000	0.519	0.481	2.079	307.7
9506	c	2	267	0.007	0.525	0.479	2.089	484.5
9507	c	15	10	0.600	0.629	0.928	1.078	25.9
9508	c	0	1340	0.000	0.594	0.406	2.466	3304.5
9509	c	2	118	0.017	0.505	0.503	1.988	238.6
9510	c	1	0	1.000	0.571	0.571	1.750	1.7
9511	c	181	73	0.713	0.609	0.855	1.170	293.7
9512	c	594	178	0.769	0.593	0.770	1.298	932.0
9513	c	10	57	0.149	0.460	0.635	1.574	70.8
9514	c	223	81	0.734	0.482	0.657	1.522	459.5
9515	c	50	77	0.394	0.558	0.728	1.373	174.3
9516	c	32	98	0.246	0.570	0.571	1.753	227.9
9517	c	39	0	1.000	0.625	0.625	1.600	62.4
9518	c	10	200	0.048	0.595	0.425	2.351	488.9
9519	c	14	125	0.101	0.593	0.453	2.209	307.1
9521	c	11	14	0.440	0.584	0.743	1.346	33.7
9522	c	56	236	0.192	0.597	0.499	2.005	585.3
9523	BM,HT	71	1	0.986	0.611	0.620	1.613	116.2
9524	MM,EN,HT	24	3	0.889	0.624	0.702	1.425	38.5
9526	c	2	18	0.100	0.561	0.487	2.052	41.0
9527	c	10	27	0.270	0.557	0.607	1.648	47.8

Table A-1. (Continued)

NEC	SOURCE RATING	C	S	C/R	k*	u(k*)	I(k*)/R	I(k*)
9528	c	4	75	0.051	0.563	0.460	2.172	169.4
9533	c	119	165	0.419	0.633	0.633	1.581	409.5
9537	c	29	8	0.784	0.524	0.668	1.496	55.3
9539	c	103	0	1.000	0.628	0.628	1.592	164.0
9541	c	1	5	0.167	0.583	0.501	1.997	12.0
9542	c	60	187	0.243	0.564	0.575	1.738	429.4
9543	c	0	4	0.000	0.576	0.424	2.360	9.4
9545	c	347	1007	0.256	0.627	0.501	1.994	2646.3
9548	c	216	1246	0.148	0.599	0.471	2.124	3105.3
9554	c	0	5	0.000	0.390	0.610	1.639	8.2
9558	c	40	6	0.870	0.586	0.674	1.483	68.2
9559	c	33	43	0.434	0.584	0.734	1.362	103.5
9561	c	56	14	0.800	0.676	0.845	1.183	82.8
9562	c	6	4	0.600	0.540	0.900	1.112	11.1
9563	c	10	7	0.588	0.620	0.922	1.084	18.4
9566	c	3	1	0.750	0.601	0.801	1.248	5.0
9571	c	2	0	1.000	0.500	0.500	2.000	4.0
9573	c	45	0	1.000	0.537	0.537	1.863	83.8
9575	c	0	170	0.000	0.624	0.376	2.658	451.8
9577	c	0	13	0.000	0.569	0.431	2.320	30.2
9579	c	180	4	0.978	0.532	0.544	1.839	338.4
9580	c	412	282	0.594	0.685	0.775	1.290	860.4
9581	c	75	35	0.682	0.671	0.985	1.016	111.7
9583	c	46	15	0.754	0.654	0.868	1.152	69.1
9585	c	8	4731	0.002	0.580	0.421	2.374	11078.5
9588	c	228	849	0.212	0.539	0.584	1.712	1785.3
9589	c	520	228	0.695	0.523	0.753	1.329	973.9
9591	c	91	82	0.526	0.654	0.730	1.369	236.9
9593	c	2231	730	0.753	0.654	0.869	1.151	3409.0
9597	c	55	8	0.873	0.554	0.634	1.576	99.3
9598	c	7	30	0.189	0.547	0.559	1.790	66.2
9901	c	0	3689	0.000	0.677	0.323	3.092	11406.7
9999	c	18	161	0.101	NA	NA	NA	NA
Total for NECs with normal s/s rotation		108891	81848	0.571		0.642	1.558	295442.4

a. Defense Grouping NECs (97XX) were excluded.
b. Sea and shore tours determined by NEC.
c. Multiple source ratings.